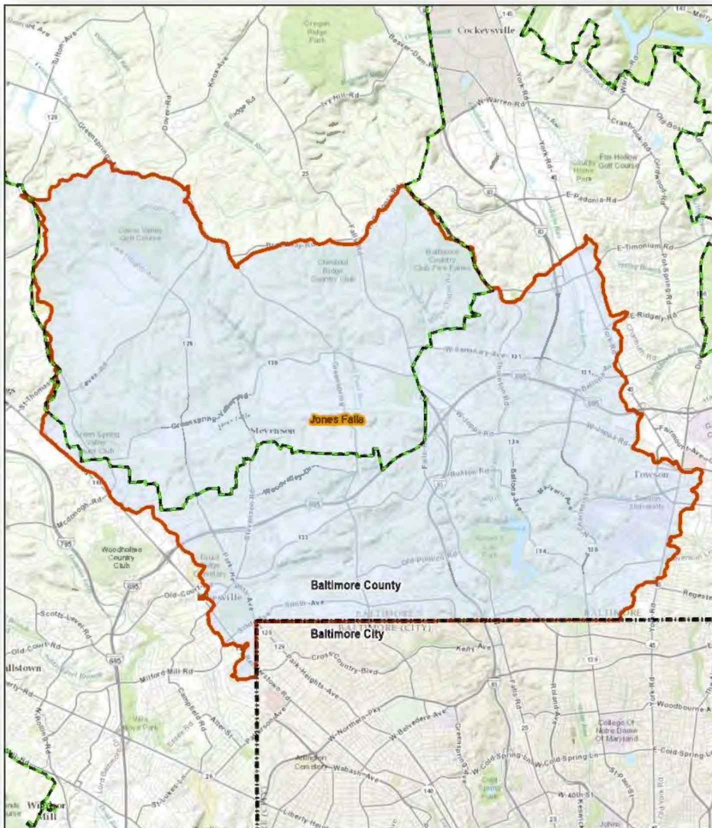
BALTIMORE COUNTY
TMDL IMPLEMENTATION PLAN

Sediment in Jones Falls



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List of Abbreviations

ARA	**Antibiotic Resistance Analysis**
BMP	**Best Management Practice**
BOD	**Biological Oxygen Demand**
BSID	**Biological Stressor Identification**
BST	**Bacteria Source Tracking**
CBP	**Chesapeake Bay Program**
CFR	**Code of Federal Regulations**
Chl a	**Chlorophyll a**
COMAR	**Code of Maryland Regulations**
CWA	**Clean Water Act**
DO	**Dissolved Oxygen**
DPW	**Department of Public Works**
ED	**Extended Detention**
EOF	**Edge of Field**

EOS	**Edge of Stream**
EPA	**U.S. Environmental Protection Agency**
EPS	**Environmental Protection & Sustainability**
FSA	**Farm Service Administration**
HSG	**Hydrologic Soil Groups**
HUC	**Hydrologic Unit Code**
IP	**Implementation Plan**
LA	**Load Allocation**
lbs/yr	**Pounds per Year**
MAST	**Maryland Assessment Scenario Tool**
MD	**Maryland**
MDA	**Maryland Department of Agriculture**
MDE	**Maryland Department of Environment**
MDP	**Maryland Department of Planning**
µg/l	**Micrograms per Liter**
mg/l	**Milligrams per Liter**
MGD	**Million Gallons per Day**
MGS	**Maryland Geological Survey**
MOS	**Margin of Safety**
MPN	**Most Probable Number**
MPR	**Maximum Practicable Reduction**
MS4	**Municipal Separate Storm Sewer System**
NLCD	**National Land Cover Dataset**
NMP	**Nutrient Management Plan**
NOAA	**National Oceanic and Atmospheric Administration**
NPDES	**National Pollutant Discharge Elimination System**
NPS	**Nonpoint Source**
NSA	**Neighborhood Source Assessment**
OIT	**Office of Information Technology**
PAA	**Pervious Area Assessment**
PAI	**Office of Permits Approvals & Inspections**
POM	**Particulate Organic Matter**
PS	**Point Source**

RTG	**Reservoir Technical Group**
SCWQP	**Soil Conservation and Water Quality Plan**
SSA	**Science Services Administration**
SSO	**Sanitary Sewer Overflow**
SWAP	**Small Watershed Action Plan**
SWM	**Stormwater Management**
TMDL	**Total Maximum Daily Load**
TN	**Total Nitrogen**
TP	**Total Phosphorus**
TSI	**Trophic State Index**
TSS	**Total Suspended Solids**
URDL	**Urban Rural Demarcation Line**
USGS	**United States Geological Survey**
USLE	**Urban Soil Loss Equation**
WAG	**Watershed Advisory Group**
WIP	**Watershed Implementation Plan**
WLA	**Waste Load Allocation**
WQBEL	**Water Quality Based Effluent Limitations**
WQIA	**Water Quality Improvement Act**
WQLS	**Water Quality Limited Segment**
WQMP	**Water Quality Management Plan**
WRAS	**Watershed Restoration Action Strategy**
WWTP	**Waste Water Treatment Plant**

This Implementation Plan (IP) has been prepared to address the sediment problem in the Jones Falls watershed that has been found to be negatively affecting the aquatic community. The amount of sediment that needs to be reduced has been determined by a Total Maximum Daily Load (TMDL) developed by Maryland Department of the Environment and, after a public comment period, submitted to US Environmental Protection Agency (EPA) – Region 3 for review and approval. EPA approved the TMDL in 2011. Final TMDL documents can be found at MDE's website under Current Status of TMDL Development in Maryland. See the document entitled: Total Maximum Daily Load of Sediment in the Jones Falls Watershed, Baltimore City and Baltimore County, Maryland.

1.1 What is a TMDL?

A TMDL has two different meanings. It is the document that is produced by MDE when any Maryland waterbody is listed on the state's 303(d) list of impaired and threatened waters. MDE must then submit the TMDL to EPA for approval. Any time a TMDL document is developed, extensive scientific study is done on the pollutant of concern in the listed waterbody. This study is done with the goal of finding the maximum load of the pollutant that the waterbody can receive and still meet Maryland's water quality standards. It is often thought of as a "pollution diet" for the watershed. All of the studying and monitoring that is done in preparing the TMDL document boils down to a single maximum load number that will be the target for pollution reduction in the waterbody. This number is also called a TMDL. In other words, the goal of the TMDL document is to justify the TMDL number, which can be found within the TMDL document.

The TMDL number is expressed as a sum of all the different sources of the pollutant plus a Margin of Safety (MOS). The MOS value helps to account for any lack of knowledge or understanding concerning the relationship between loads and water quality and also for any rounding errors in the TMDL calculation (calculation format shown below). Expressing the TMDL in terms of this simple equation makes it easier to see where pollution reduction efforts need to be focused. In other words, which sources can be reduced to reach the final TMDL number, by how much they need to be reduced, and which pollution sources are not practical for reduction. The sources that make up the final TMDL number are categorized as either Load Allocation (LA) or Waste Load Allocation (WLA). LAs are all nonpoint source loads, meaning that they do not come from a single source or pipe. LAs include agricultural runoff, forest runoff, and upstream loads. WLAs are all point source loads, meaning that they do come from a single traceable source. WLAs are further categorized as process water or stormwater. Process water WLA comes from sources that have permits allowing them to release a specific amount of a pollutant into the water. They include individual industrial facilities, individual municipal facilities, and mineral mining facilities. Stormwater WLA is any stormwater that is regulated by a municipal separate storm sewer systems permit (MS4), water from industrial facilities permitted to release stormwater, and all runoff from construction sites. All Baltimore County urban stormwater is regulated under Baltimore County's MS4 permit. That means that stormwater WLA includes all of the water that runs to any storm drain within the watershed area. The MOS is the final part of the equation. The MOS can be implicit, meaning that the final TMDL was calculated in such a way that it accounted for any errors without needing to tack an explicit MOS to the end of the sum of load sources equation. When an explicit MOS is necessary, it is assumed that a 5% reduction of the final TMDL number will be sufficient.

TMDL Sum of Load Sources Equation:

$$\textbf{TMDL} = \textbf{LA} + \textbf{WLA Stormwater} + \textbf{WLA Process Water} + \textbf{MOS}$$

1.1.1 How is the Final TMDL Determined

The process of determining the TMDL number can be very complex. Pollution data are regularly collected throughout Maryland by many different federal, state, and local government agencies as well as universities and watershed organizations. The agency or organization may send individuals out to the stream to collect and measure information about the watershed as part of a study or regular monitoring program. Data are also collected from the many different monitoring stations that are located throughout Maryland's watersheds. Some of these monitoring stations have been collecting water data for tens of years. The U.S. Geological Survey and the Maryland Department of Natural Resources monitoring stations are often used as the data source for Maryland TMDLs. To find out who is keeping an eye on your watershed see MDE's Water Quality Monitoring Web Page.

Complex scientific models are often used to help find a practical number for the total reduction. Models often use existing monitoring data and observations about the watershed area in a calculation that determines the TMDL number. The type of model used and the complexity of the model varies by pollutant, waterbody type, and complexity of flow conditions. The specific model used for this TMDL is explained in section 3.3.

In all cases, scientists first find a baseline load for the pollutant. The baseline load is how much of the pollutant is in the waterbody at the time of the study, before restoration actions specifically developed to reach the TMDL number are implemented. The calculated target number, that is the TMDL, is the final goal. It could be thought of as the finish line in the TMDL process. That is not to say that other restoration efforts will not continue once that target is reached, but that the waterbody will be able to meet state water quality standards and can be removed from the list of impaired and threatened waters for that particular pollutant .

When calculating the TMDL number, a percent reduction and load reduction are usually calculated as well. The load reduction is the difference between the baseline load and the TMDL target. Think of it as the amount that needs to be removed from the system in order to reach the target. The percent reduction is the percentage of the baseline load that needs to be removed in order to reach the TMDL target.

1.2 Geographic Area

Pollution reduction goals are determined by watershed. A watershed is all the land area where all of the water that runs off that land and all the water running under that land drain into the same place. Everything within a watershed is linked by a common water destination. Watersheds exist at many levels: some very large, and some quite small. Identifying your watershed is similar to identifying your current location on a map. You could say you are in the United States, or that you are in Maryland, or that you are in your kitchen at your specific street address. Similarly, you could say that you are in the Mid-Atlantic Region Watershed, which drains to the Atlantic Ocean, Long Island Sound and Riviere Richelieu, a tributary of the St.

Lawrence River. You could also say that you are in the Upper Chesapeake Bay Watershed, which includes the area of drainage to the Chesapeake Bay that is north of the Maryland-Virginia line. Both would describe a watershed that you are located in. However, watersheds can become much more specific.

A system was established by the U.S. Geologic Survey for dividing the U.S. into successively smaller hydrologic units. Each hydrologic unit is identified by a hydrologic unit code (HUC), which range from two to twelve digits. The smaller the scale of the watershed, the more digits it has in its code. For example, the Mid-Atlantic Region is a 2-digit watershed and the Upper Chesapeake Bay is a 4-digit watershed. The 6-digit unit, also known as the "basins" unit, is to serve as the common scale for watershed assessments at the national level, but the condition of these basins can be determined based on an aggregation of assessments of even smaller watershed units. Maryland has chosen to go the route of assessing smaller watershed units. As a result, TMDLs are determined at the 8-digit watershed scale. For a further explanation of HUCs or to see maps of watersheds at different HUC levels, go to: USGS Hydrologic Unit Maps. If you would like to know which Maryland 8-digit watershed you are located in, go to MDE's Find My Watershed Map.

It is important to note that 8-digit watersheds can overlap multiple counties and may, therefore, have several regulating authorities.

1.2.1 Jones Falls Geographic Area

The Jones Falls is an 8-digit (02-13-09-04) watershed that covers a total land area of 34,122 acres. The watershed originates in Baltimore County and continues through Baltimore City to the tidal waters of the Northwest Branch (Inner Harbor) of Baltimore Harbor. The Baltimore County portion of the watershed comprises 25,399 acres or 76% of the land area of the watershed (Figure 1.1).

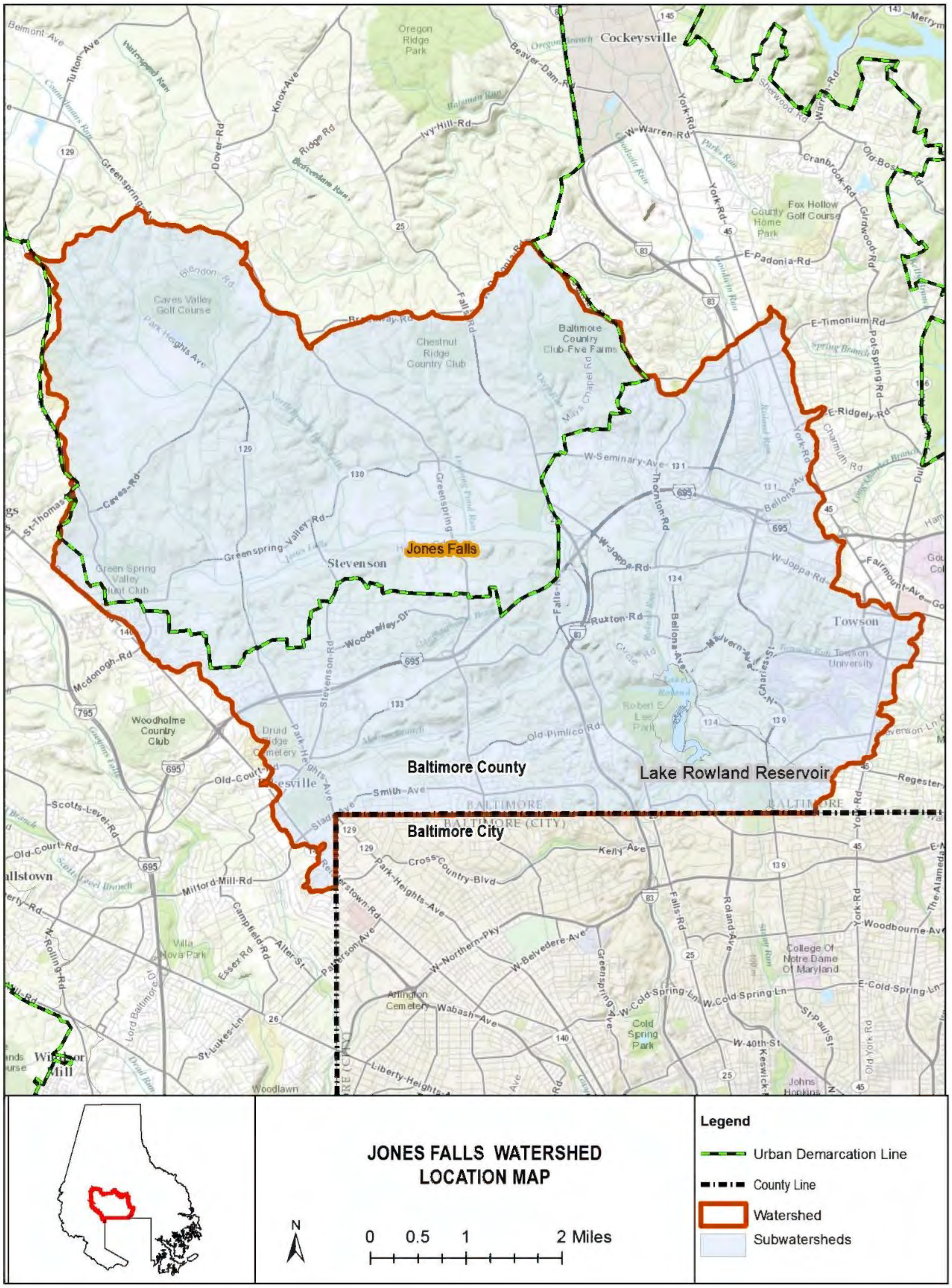

Figure 1.1: Jones Falls Watershed, Baltimore County Portion

1.3 Goal of the TMDL Implementation Actions

TMDL Implementation Plan Objective:

Through a cooperative effort of Baltimore County Department of Environmental Protection and Sustainability, other county agencies, local watershed associations, and the general public, to provide a comprehensive plan of action for achieving TMDL targets and ultimately restoring the health of Baltimore County waters to acceptable water quality standards.

Water quality standard for sediment in the Jones Falls watershed:

To return the sediment levels in the watershed to a level that supports the growth and propagation of aquatic life.

This will ultimately be measured by an index of biotic integrity. Measurements of water quality for the Jones Falls will be further discussed in section 3.

1.4 Document Organization

The Baltimore County TMDL implementation plans provide the following information to explain the necessity of the TMDL Implementation Plan and to develop a management strategy that will be followed in order to meet county TMDL reduction targets. The County will take an adaptive management approach that will include periodic assessments to determine progress and identify changes needed in the management strategy to meet the reduction targets in a timely, cost effective manner.

Section 1 - Introduction

This Introduction states the pollutant that is being addressed by the TMDL IP, and the watershed for which the IP was developed. It provides a background on what a TMDL is and how the TMDL is determined. A general description of the geographic area for the specific IP is provided. The Introduction also states the overall goal of the TMDL IP and summarizes the actions that have been identified to bring Baltimore County to that goal. It also includes a brief summary of the contents of the thirteen sections of the TMDL Implementation Plan.

Section 2 - Regulatory Policy and Planning

This part of the document describes the administration and legal authority that mandates the development of Baltimore County's TMDL implementation plan and oversees its fulfillment. It will provide a background of how various regulating authorities and policies are related to the requirement to develop a TMDL Implementation Plan. It will also summarize the various planning guidance documents that have been produced to assist in the development of TMDL Implementation Plans and how TMDL Implementation Plans fit in the overall Baltimore County planning context.

Section 3 - TMDL Summary

The section summarizes the original TMDL document that was submitted by MDE and approved by the EPA. The summary includes: when the TMDL was developed, what is impaired, why the TMDL was developed, a description of the analysis process that was used to determine the total maximum daily load targets, the baseline year of data collection and analysis, the results from that analysis, and a further break down of the target loads by source sector.

Section 4 - Literature Summary

Each TMDL IP will address a specific pollutant. This part of the document provides an overview of the pollutant that is summarized from published literature. The literature summary includes known sources of the pollutant, the impacts associated with the pollutant, the pathways and transformations of the pollutant, and other relevant ecological processes that affect how the pollutant can be controlled and regulated.

Section 5 - Watershed Characterization

Characterization of the watershed will include geographical and technical information for the portion of the watershed that is specific to each TMDL IP. Each characterization will describe the watershed acreage, population size, geology and soils, topography, land use, streams, infrastructure related to watershed pollution sources, implemented restoration projects since the baseline year, and changes in pollutant load since the baseline year.

Section 6 – Existing Data Summary

This section will include a summary of Baltimore County's existing monitoring data that will be pertinent to the pollutant in question. It may also include some data received from sources other than Baltimore County, such as data from the Maryland Department of the Environment, or other relevant sources.

Section 7 - Summary of Existing Restoration Plans

Previous planning efforts will be summarized in this section. Water Quality Management Plans (WQMP) and Small Watershed Action Plans (SWAP) applicable to the IP area are identified. The process and goals for SWAP development are explained.

Section 8 - Best Management Practice Efficiencies

This section is an explanation of the best management practices that will be used for removing the particular pollutant and the known efficiency of those best management practices. A table will be found in this section of BMPs and the known reduction efficiency for the pollutants that can be reduced by each BMP. BMP efficiencies will also include a discussion of the uncertainty and research needs for BMPs.

Section 9 - Implementation

The implementation section will provide a description of programmatic, management, and restoration actions; and pollutant load reduction calculations to meet the pollutant reduction target for the specific pollutant. For each of the programmatic, management, and restoration actions there will be a list of responsible parties, actions, timeframe of actions, and performance standards.

Section 10 - Assessment of Implementation Progress

Assessment of implementation progress will give Baltimore County a formal method of reporting on the development of implementation and of describing the progressive success of implementation actions. The section will include a description of tracking and reporting mechanisms, and a monitoring plan that includes progress monitoring as well as BMP effectiveness monitoring.

Section 11 - Continuing Public Outreach Plan

This part of the document will be a continuing public outreach plan. It will encourage public involvement in the implementation process, extending beyond the finalization of this document.

Section 12 - References

A list of references used in the creation of this document will be provided.

Section 2 - Legal Authority, Policy, and Planning Framework

The Legal Authority, Policy, and Planning Framework section will present, in brief, the background on the legal requirements that pertain to the development of Total Maximum Daily Loads (TMDLs), and the preparation of TMDL Implementation Plans. This section will also cover the planning framework for the development of the TMDL Implementation Plans (IP). Furthermore, this section is intended to provide the context for the development of this TMDL Implementation Plan and understanding of the linkage between water quality and the TMDL. Whether at the federal or state level there are a number of processes at work that result in the regulations that must be followed to remain within the law. First, legislation is passed by an elected governing body (e.g. Congress, state legislature), and once passed and signed by the executive branch, they become Acts (laws), such as the Clean Water Act. In order to provide guidelines in maintaining compliance with these laws, it is often necessary that regulations be issued to specify the law's requirements. A regulation is a rule issued by a government agency that provides details on how legislation will be implemented, and may set specific minimum requirements for the public to meet if they are to be considered in compliance with the law. These regulations may come in various forms, such as the Code of Federal Regulations (CFR), or Code of Maryland Regulations (COMAR). The information that follows is generally taken from CFR and COMAR.

Under the CFR, Title 40 encompasses the regulations enforced by the U.S. Environmental Protection Agency (EPA). These regulations include not only those related to water quality, but also air quality, noise, and a variety of land based regulations (oil operations, etc.)

2.1 Regulatory and Policy Framework

The ultimate regulatory authority for protecting and restoring water quality rests with the federal government through legislative passage of the Clean Water Act in 1972 and subsequent amendments. Prior to the Clean Water Act (1972), the Federal Water Pollution Control Act (1948) served as the basis for controlling water pollution. The Clean Water Act significantly amended the Federal Water Pollution Control Act and established the basic structure for regulating discharges of pollutants into the waters of the United States. Major amendments were enacted in 1977 and 1987 that further strengthened and expanded the Clean Water Act of 1972. The 1987 amendments incorporated the requirement that stormwater discharges from urban (municipal) areas be required to obtain a permit for discharge and that stormwater discharges from industrial sources also be permitted. There have been a number of minor amendments and reauthorizations over the years that have resulted in the law as it now stands.

There are several significant provisions of the Clean Water Act that pertain to TMDLs. These provisions include the requirement that states adopt Water Quality Standards by designating waterbody uses and set criteria that protect those uses. The Clean Water Act also requires states to assess their waters and provide a list (known as the 303(d) list) of waters that are impaired. The list specifies the impairing substance and requires that a TMDL be developed to address the impairment.

Through policy (memos dated November 22, 2002 and November 12, 2010) the US EPA has indicated that the pollutant loads attributable to regulated stormwater discharges are to be included in the Waste Load Allocation as a point source discharge and not as part of the nonpoint load. The initial memo also affirmed that the Water Quality-Based Effluent Limitations (WQBELs) in Municipal Separate Storm Sewer System (MS4) permits may be expressed in the form of Best Management Practices (BMPs) and not as numeric limits for stormwater discharges. The second memo clarified that when the MS4 permits are expressed in the form of BMPs, the permit should contain objectives and measurable elements (e.g., schedule for BMP installation or level of BMP performance). By providing both an expected level of BMP performance and a schedule of implementation of the various practices, Baltimore County will have addressed this requirement. This plan once approved by Maryland Department of the Environment (MDE) will be enforceable under the terms of the permit.

2.2 Maryland Use Designations and Water Quality Standards

In conformance with the Clean Water Act, the State of Maryland has developed use designations for all of the waters in the state of Maryland, along with water quality standards to maintain the use designations.

Designated uses define an intended human and aquatic life goal for a waterbody. It takes into account what is considered the attainable use for the waterbody, for protection of aquatic communities and wildlife, use as a public water supply, and human uses, such as recreation, agriculture, industry, and navigation. Water quality standards include both the Use Designation and Water Quality Criteria (numeric standards). Water Quality Criteria are developed to protect the uses of a waterbody.

2.2.1 Use Class Designations

Every stream, lake, reservoir, and tidal waterbody in Maryland has been assigned a Use Designation. The Use Designation is linked to specific water quality standards that will enable the Designated Use of the waterbody to be met. A listing of the Use Designations follows:

- Use Class I: Water contact recreation, and protection of nontidal warm water aquatic life.
- Use Class II: Support of estuarine and marine aquatic life and shellfish harvesting (not all subcategories apply to each tidal water segment)
    - Shellfish harvesting subcategory
    - Seasonal migratory fish spawning and nursery subcategory (Chesapeake Bay only)
    - Seasonal shallow-water submerged aquatic vegetation subcategory (Chesapeake Bay only)
    - Open-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-channel refuge use (Chesapeake Bay only)
- Use Class III: Nontidal cold water – usually considered natural trout waters
- Use Class IV: Recreational trout waters – waters are stocked with trout

The letter “P” may follow any of the Use Designations, if the surface waters are used for public water supply. There may be a mix of Use Classes within a single 8-digit watershed; for example, Gwynns Falls has Use I, Use III, and Use IV Designations depending on the subwatershed.

Table 2.1: Designated Uses and Applicable Use Classes

Designated Uses	Use Classes							
	I	I-P	II	II-P	III	III-P	IV	IV-P
Growth and Propagation of fish (not trout), other aquatic life and wildlife	✓	✓	✓	✓	✓	✓	✓	✓
Water Contact Sports	✓	✓	✓	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface water	✓	✓	✓	✓	✓	✓	✓	✓
Fishing	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Industrial Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Propagation and Harvesting of Shellfish			✓	✓				
Seasonal Migratory Fish Spawning and Nursery Use			✓	✓				
Seasonal Shallow-Water Submerged Aquatic Vegetation Use			✓	✓				
Seasonal Deep-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Channel Refuge Use			✓	✓				
Growth and Propagation of Trout					✓	✓		
Capable of Supporting Adult Trout for a Put and Take Fishery							✓	✓
Public Water Supply		✓		✓		✓		✓

2.2.2 *Water Quality Criteria*

Water quality criteria are developed to protect the uses designated for each waterbody. Certain standards apply over all uses, while some standards are specific to a particular use. The criteria are based on scientific data that indicate threats to aquatic life or human health. For the protection of aquatic communities the criteria have been developed for fresh water, estuarine water, and salt water. The criteria have been further based on acute levels (have an immediate negative effect) and chronic levels (have longer term effects). The human health criteria are based on drinking water levels, organism consumption levels, or a combination of drinking water and organism consumption levels, or recreational contact bacteria levels.

Dissolved oxygen criteria for all Use Designations is 5 mg/L, except for Use II Designations and special criteria for drinking water reservoir hypolimnion waters (bottom waters of the reservoir).

Bacteria criteria are based on human health concerns, and apply to all Uses, with additional bacteria criteria applicable in shellfish waters. Since none of the local TMDLs are related to the shellfish criteria, they are not discussed here. The human health criteria are based on either the geometric mean of 5 samples or single sample criteria based on the frequency of full body contact, these criteria are displayed in Table 2.2. For the freshwater bacteria TMDLs the indicator bacteria *E. coli* has been used in the development of the TMDL, therefore it serves as the water quality end point. The human health recreational contact bacteria criteria are displayed in Table 2-2. The table displays both the geometric mean for bacteria and single sample maximum allowable bacteria concentrations based on the frequency of full body contact.

Table 2.2: Bacteria Criteria for Human Health (MPN/100 ml)

Indicator	Steady State Geometric Mean Density	Single Sample Maximum Allowable Density			
		Frequent Full Body Contact Recreation	Moderately Frequent Full Body Contact Recreation	Occasional Full Body Contact Recreation	Infrequent Full Body Contact Recreation

Freshwater (Either Apply)					
Enterococci	33	61	78	107	151
E. coli	126	235	298	410	576
Marine					
Enterococci	35	104	158	275	500

2.3 Planning Guidance

In March of 2008 the EPA released a guidance document on the development of watershed plans entitled *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. The handbook laid out nine minimum elements to be included in watershed plans, commonly called the "a through i" criteria. The criteria include:

a. An identification of the causes and sources or groups of sources that will need to be controlled to achieve the load reductions estimated in the watershed plan.

b. Estimates of pollutant load reductions expected through implementation of proposed Nonpoint Source (NPS) management measures.

c. A description of the NPS management measures that will need to be implemented.

d. An estimate of the amounts of technical and financial assistance needed to implement the plan.

e. An information/education component that will be used to enhance public understanding and encourage participation.

f. A schedule for implementing the NPS management measures.

g. A description of interim, measurable milestones for the NPS management measures.

h. A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards.

i. A monitoring component to evaluate effectiveness of the implementation efforts over time.

EPA now evaluates watershed plans on the basis of the above criteria in consideration of its grant funding. The State of Maryland is also increasingly using the above criteria for funding consideration. Baltimore County has used these criteria since the publication of the handbook in the development of its Small Watershed Action Plans; and will use the criteria in the development of this TMDL Implementation Plan.

MDE developed a guidance document in conjunction with local government representatives entitled *Maryland's 2006 TMDL Implementation Guidance for Local Governments*, which provides a framework for the development of TMDL Implementation Plans. MDE has also provided guidance on the development of TMDL Implementation Plans related to specific pollutants. Guidance for specific pollutants includes:

- PCBs
- Bacteria
- Mercury
- Trash

These guidance documents have been taken into consideration in the development of the Baltimore County TMDL Implementation Plans.

2.4 Water Quality Standards Related to This Implementation Plan

The Jones Falls (02-13-09-04) watershed has a Use I and Use III Designation in Baltimore County. Use I includes water contact recreation and protection of warm water fisheries, while Use III includes water contact recreation and cold water fisheries. The water quality criteria applicable to the sediment TMDL include biological community criteria and sediment related criteria.

There are no specific sediment criteria, but there are criteria related to turbidity, which is a function of suspended solids. The criteria specify:

(5)(a) Turbidity may not exceed levels detrimental to aquatic life.

(5)(b) Turbidity in the surface water resulting from any discharge may not exceed 150 units at any time or 50 units as a monthly average. Units shall be measured in Nephelometer Turbidity Units (NTU).

The biological water quality criteria are found in COMAR 26.08.02.03-4 and specify:

A. *Quantitative assessments of biological communities in streams (biological criteria) may be used separately on in conjunction with the chemical and physical criteria promulgated in this chapter to assess whether water quality is consistent with the purposes and uses in Regulations .01 and .02 of this chapter.*
B. *The results of the quantitative assessments of biological communities shall be used for purposes of water quality assessment, including, but not limited to, those assessments required by §§303(d) and 305(b) of the federal Clean Water Act (33 U.S.C. §§1313(d) and 1315(b)).*
C. *These assessments shall use documented methods that have been subject to technical review, produce consistent and repeatable results, and are objectively interpretable.*
D. *In using biological criteria to determine whether aquatic life uses are being met, the Department shall allow for the uncertainty and natural variability in environmental monitoring results by using established quantitative and statistical methodologies to establish the appropriate level of uncertainty for these determinations.*
E. *The Department shall determine whether the application and interpretation of the assessment method are appropriate. In those instances where the Department determines the assessment method is not appropriate, it will provide its justification for that determination.*

To determine impairment listings due to aquatic biological community condition, the biological data are analyzed on an 8-digit watershed scale. If the biological scores for benthic macroinvertebrates and fish indicating degraded stream conditions are significantly different than reference condition watersheds (ie. healthy stream, <10% degraded), then the watershed is determined as not meeting biological water quality criteria. Index scores below 3.0 for the benthic community and fish are considered degraded. Based on the *Watershed Report for Biological Impairment of the Jones Falls Watershed in Baltimore City and Baltimore County, Maryland: Biological Stressor Identification Analysis Results and Interpretation* (MDE 2012) eight of twenty-two monitoring sites had scores less than 3.0 indicating that 36% of the stream miles are in a degraded condition. This report also determined that the aquatic community was impacted by chlorides, conductivity, and sulfate.

The water quality end point to be achieved is biological scores greater than 3.0. Baltimore County will assess this end point on a subwatershed basis and use existing data for targeting impaired subwatersheds.

The TMDL summary provides context for the TMDL implementation plan. It is necessary to understand some basic information from the original TMDL document that preceded this particular implementation plan. The TMDL document describes the condition of the watershed at the time that the baseline load of the pollutant was calculated. The baseline load is simply a measurement of the amount of the pollutant that was in the waterbody during a specific time. The baseline load provides a starting pollutant measurement for the county to reduce from, in order to meet the TMDL target. The term TMDL is also used to describe the specific numeric load target, which is explained in detail within the TMDL document. The original TMDL document provides a detailed justification for choosing the TMDL target number. This justification is a description of the entire technical process including monitoring methods and calculations. The following section is a simplification of that section of the TMDL document and a brief explanation of why the TMDL was developed for the specific pollutant in this watershed.

3.1 TMDL Background

- **The Problem**: The TMDL was developed because sedimentation was found to be degrading the health of aquatic organisms in the Jones Falls.

The Jones Falls was listed as being impaired by sediment in 1996. MDE developed the TMDL and submitted it to EPA in 2009. It was approved by EPA in 2011.

An Index of Biotic Integrity (IBI) was used to determine biological impairment and a Biological Stressor Identification Analysis (BSID) was used to determine that sediment was the primary cause of that biological impairment.

IBI is the preferred tool for measuring the health of the aquatic community in a particular waterbody. An IBI score is a numerical measure of the completeness (Integrity) of the biological community. The Jones Falls TMDL involves two different types of IBI measurement: a Fish IBI (F-IBI) and a benthic macroinvertebrate IBI (B-IBI). An IBI score is determined by taking a series of samples of the community from different areas of the stream. A number of metrics are evaluated for the samples and are then used to calculate the IBI score. The Biological Assessment of Water Quality for Non-tidal Streams is a document that is produced by MDE that explains the accepted methodology for assessing biological impairment in Non-tidal streams. It describes how both F-IBI and B-IBI are used in Maryland to evaluate biological data for Clean Water Act requirements.

Notice that IBIs are affected by a wide range of stressors. Even if the TMDL target for sediment is reached and water quality standards for sediment are restored, it is possible that other factors could keep the IBI from reaching a healthy score. There is currently no standard test that can exclusively measure sediment's affect on the health of aquatic life. There is also no sediment concentration standard in Maryland.

Although it is not possible to exclusively measure the affect of sediment on the health of aquatic life, the BSID analysis is designed to systematically and objectively determine the predominate cause of the reduced biological conditions. The IBI identified that a biological impairment exists, but the BSID verified that sediment was the primary impairing substance. For more information on the BSID analysis, see the Watershed Report for Biological Impairment of the Jones Falls.

The sediment load in the Patapsco LNB 8-digit watershed was studied over an extensive time period. The data used to determine this particular TMDL was gathered from round 2 data of the Maryland Biological Stream Survey (MBSS) (see: Maryland Biological Stream Survey at DNR web-page) and supplemented by CORE/TREND Data (see: Benthic Macroinvertebrates and Maryland's Core Trend Monitoring Stations). Both are water quality monitoring programs of the Maryland Department of Natural Resources (DNR) and both involve collecting and analyzing samples of benthic macroinvertebrtes for species diversity. Benthic macroinvertebrates are organisms without backbones that are visible without a microscope. They live on, under or around rocks and debris on the bottom of lakes, rivers, and streams. They act much like the canary in a coal mine, but for watersheds. Some species are more tolerant to pollutants than others. The absence of less pollutant tolerant macroinvertebrate species usually indicates that a pollutant has be present long enough and in high enough concentrations to kill off those organisms in that area. This is often seen as an early indication that the pollutant could cause harm to other species. The death of organisms from sedimentation can occur from accumulation over timer, such as in the case of habitat modification, or can be an immediate death, such as in the case of smothering. The MBSS round 2 also involved the collection of fish for analysis of species diversity, so fish data from the MBSS was used as well. The data provided the information necessary to calculate a final IBI score for both fish and macroinvertebrates for the stream.

The CORE/TREND data was collected from 1976 to 2006 and round 2 MBSS data was collected from 2000 to 2004. It was determined that 2006 will be used as the baseline year of the data collection for this TMDL implementation plan.

3.2 TMDL Development

A critical step in the TMDL process is establishing the method by which the TMDL targets will be determined. This particular TMDL was developed using a reference site approach. Reference sites are determined based on Maryland's biocriteria methodology, which utilizes both B-IBI and F-IBI. Reference watersheds are determined based on calculated IBI scores at MBSS stations Reference watersheds are those with average IBI scores indicating good biological health for the watershed overall. Watershed impairment is evaluated by the percentage of MBSS stations within the watershed that are below an IBI minimum allowable limit in comparison to reference conditions. Any watershed that is significantly different than the reference condition must be listed as a category 5, impaired water. 36% of stream miles in the Jones Falls watershed had degraded biological conditions when compared to regional reference sites.

Sediment loads for the Jones Falls were compared to reference sites with similar physical and hydrological characteristics. Nine reference watersheds were selected from the Highland/Piedmont region. Sediment loads were then normalized with background conditions that would be present in a watershed surrounded by all forest cover. This condition is known as the all forested sediment load. The forest normalized sediment load represents how many times greater the current sediment load is compared to the all forested sediment load. The median and 75th percentile of reference watershed forest normalized sediment loads were found to be 3.3 and 4.2 respectively. The median value of 3.3 was used as the sediment load threshold.

It was determined that the threshold could most efficiently be attained by applying reductions to the predominant controllable source. For this TMDL, urban land was identified as the most extensive controllable source. MDE already requires that Baltimore County, as a result of their Phase I MS4 permit, retrofit 10% of impervious surfaces every permit cycle (5 years); with the most recent renewal of the Baltimore County MS4 permit (12/23/13), the amount of impervious surface required to be retrofit was increased to 20% over the five year period of the permit. MDE estimates that future stormwater retrofits will reduce total suspended solids by an average of 65%. For this TMDL, these retrofits were considered to be the maximum feasible urban stormwater reductions and should be the method for meeting the TMDL endpoint.

3.3 TMDL Results

The TMDL endpoint was calculated as the product of the sediment load threshold (3.3) and the all forested sediment load (Background load). The result is considered the maximum allowable sediment load that the watershed can sustain without negative impacts to aquatic health, also known as the TMDL.

In order to achieve the TMDL, reductions are applied to the predominant controllable sources. The TMDL will result in a 21.9% overall reduction of sediment in the Jones Falls watershed.

Table 3.1: TMDL Summary Jones Falls Watershed

Baseline Load (ton/yr)	Target Load Reduction (ton/yr)	TMDL (ton/yr)	Total Reduction (%)
9,104.9	1,995.6	7,109.3	21.9

3.4 TMDL Reductions Targets by Source Sector

TMDLs must be presented as a sum of waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint source loads and a margin of safety (MOS).

- LA: Nonpoint sources were not targeted for reduction in this TMDL
- WLA: The WLA consists of two permitted sources: process water WLA and stormwater WLA.
    - Process water permits with specific TSS include municipal facilities, and mineral mining facilities. There was no reduction applied to these sources because they are not a significant portion of the total load.
    - Stormwater WLA can include MS4 regulated stormwater, industrial facilities permitted to discharge stormwater, and construction sites.
- MOS: The margin of safety is implicit because the forest normalized sediment load was considered to be an environmentally conservative estimate.

Table 3.2: Jones Falls TMDL reductions by source category

Baseline Load Source Categories		Baseline Load (ton/yr)	TMDL (ton/yr)	Reduction (%)
LA: Nonpoint Source		1,022.0	1,022.0	0.0%
WLA: Point Sources	Urban Stormwater	8,080.5	6,084.9	24.7%
	Permits	2.4	2.4	0.0%
MOS			Implicit	
Total		9,104.9	7,109.3	21.9

3.5 TMDL Load Allocations for NPDES Regulated Stormwater Point Sources

Baltimore County is responsible for the portion of the load that enters waters within Baltimore County boarders. The county will have a unique TMDL that accounts for the County Phase I MS4 load as well as any other facilities releasing NPDES regulated stormwater within the county boundaries. Allocations by NPDES regulated stormwater point sources for the Jones Falls can be found in the Technical Memorandum of the TMDL document. The following is a simplified version of that table.

Table 3.3: Allocations for NPDES Regulated Stormwater Point Sources

NPDES Regulated Stormwater Point Source	Baseline Load (ton/yr)	WLA (ton/yr)	MDL (ton/day)	Reduction (%)
Baltimore County Phase I MS4	1,961.3	1,532.3	61.3	21.9
Baltimore City Phase I MS4	4,733.3	3,489.2	139.6	26.3
SHA Phase I MS4	209.1	163.7	6.5	21.7
"Other NPDES Regulated Stormwater"	1,176.8	899.7	36.0	23.6
Total	**8,080.5**	**6,084.9**	**243.4**	**24.7**

This review pertains to direct and indirect effects of sediment on fresh water rivers and streams, specifically those effects that are relevant to the Jones Falls. This is not intended to be an exhaustive review of primary literature, but rather a summary of the sources, pathways and biological effects of sediment in non-tidal watersheds from literature available to Baltimore County Department of Environmental Protection and Sustainability.

Sediment is solid soil or rock material (e.g. pebbles, sand, dirt, mud, particulate organic material) that is transported by wind, water or ice, or is secreted or carried by organisms, or precipitated from a solution, i.e., chemical sedimentary rocks (U.S. Geological Survey and U.S Department of the Interior 2003). The effects of sediment on a water ecosystem are multi-dimensional (Berry, Rubinstien and Melzian 2003). Stream channels are inherently dynamic systems that change in their width, slope, shape, depth, meander pattern and bed material over time (Berry, Rubinstien and Melzian 2003) (Davis 2009) . Fluctuations in the sediment load occur naturally and are a vital part of the aquatic system. Sediment stress results when significant changes to the normal sediment load occur, compromising the ecological integrity of the water ecosystem (Berry, Rubinstien and Melzian 2003).

Sediment has different impacts on the system depending on the particle size. Classifications include bottom deposition sediment and suspended sediment. Course sediment is typically transported along the bottom of the river or stream, while silt and clay sediments become suspended in the water column. Turbidity is a measure of the water's cloudiness as a result of suspended sediment. Suspended sediment can include material that is large enough to eventually settle as bottom deposition. It can also include particles that fluctuate, through natural processes, between suspensions and deposition. Suspended sediment particles that are small enough to settle very slowly, or not at all, are those that contribute to the problem of turbid water (Berry, Rubinstien and Melzian 2003). Deposited sediment can create unique problems for aquatic life as well. The rate of flow of the river or stream determines what size particles become suspended or deposited (Davis 2009). Faster moving water has the power to move larger particles. Because the rate of water flow changes with water volume, the maximum size of particles in suspension is also subject to change. See USGS Summary Report on Sediment Processes: Chapter 3Watershed Sediment Transport and Chapter 4 Watershed Sediment Deposition and Storage. By the processes of re-suspension and deposition sediment can be re-introduced into the water column or deposited to the river or stream bed (Colorado Department of Public Health and the Environment Water Quality Control Commission Water Quality Control Division 2005).

Sediments enter the waterbody through a wide variety of transport mechanisms, including surface water (e.g. stormwater runoff), bank sloughing, and atmospheric deposition. See the USGS Summary Report on Sediment Processes: Chapter 2 Watershed Sediment Sources. Upland and bank erosion contribute to nonpoint sources of the sediment load. Anthropologic activities enhance the erosion process (Booth and Henshaw 2000). Those activities include construction, mining, farming, urban development, and dredging (Berry, Rubinstien and Melzian 2003).

Erosion rates differ by land use. Estimates of average annual erosion rates help to determine the amount of sediment delivered to the waterbody, but not all eroded sediment enters the river. The average annual erosion rate from the land is known as the edge-of-field (EOF) erosion, but the edge-of-stream (EOS) is what actually enters the river reaches. The EOS is calculated using the EOF, but also takes into account the deposition of sediment on hillsides, and sediment transport through smaller streams and rivers (Maryland Department of the Environment 2011).

Stream bank erosion is aggravated by high water flows during storm events. Impervious surfaces, such as parking lots, roads, and rooftops are directly connected to the stream channel via the storm sewer system. This causes water to flow more rapidly into the stream during a storm event without the natural filtration that occurs when rain water runs through vegetation and soil. The outcome is higher water flows in the stream channel during storms and higher sediment content in the streams and rivers. The stress of these high flows through the stream and river channels wears away at the banks, causing higher than normal bank erosion (Booth and Henshaw 2000) (Maryland Department of the Environment 2011).

A study produced by U.S. Geological Survey on sediment processes in the Chesapeake Bay watershed found that river basins with the highest percentage of agricultural land use have the highest annual sediment yields (U.S. Geological Survey and U.S Department of the Interior 2003). Basins with the highest percentage of forest cover were found to have the lowest annual sediment yields. The study also found that urbanization can more than double the background sediment yield (U.S. Geological Survey and U.S Department of the Interior 2003). This urban sediment is highest during construction phases and then declines after the initial development is complete. In some instances, when construction alters stream hydrology, the sedimentation rate remains high because the erosion of stream banks continues long after development (U.S. Geological Survey and U.S Department of the Interior 2003). For more information on urbanization and sedimentation, see: U.S. EPA Urbanization and Streams: Studies of Hydrologic Impacts.

Sediment can affect humans by reducing water clarity, which is not aesthetically pleasing. It can also reduce cleanliness of water for swimming or recreational activities, as well as drinking.

An overabundance of sediment in the water column, resulting in cloudy water, inhibits light penetration. This can be a problem for predators, as both big and small fish hunt primarily by sight (Berry, Rubinstien and Melzian 2003) (Lester 2013). When fish and other aquatic animals cannot see their prey, their ability to capture food is limited. Murky water is a problem for both large and small fish, but smaller fish that feed on zooplankton can have an advantage, to a degree, of not being seen as easily by predators while scavenging for food. However, too much cloudiness, negates this advantage and both large and small fish will find it difficult to get enough food for their survival (Lester 2013).

Excessive sediments can also destroy valuable aquatic habitats for fish, aquatic invertebrates, and algae (Berry, Rubinstien and Melzian 2003) (Lisle 1989). Fish habitats are affected when fine sediment settles into spawning gravels, reducing oxygen levels in the spaces between gravel particles. Spawning gravels are stream bed materials that females excavate to form nests for egg laying. During excavation, females minimize fine sediment particles to enhance gravel permeability and oxygenate the eggs. Decreased oxygenation due to sedimentation can lead to a reduction in survival and growth rates (Colorado Department of Public Health and the Environment, 2005; Lisle 1989). Sedimentation can also negatively affect fish through loss of food sources and loss of habitat variety that normally result from natural variations in steam morphology (Colorado Department of Public Health and the Environment Water Quality Control Commission Water Quality Control Division 2005).

Aquatic invertebrates can suffer habitat loss due to sedimentation in addition to being smothered by fine sediments that settle into rocks and gravel. Chapman and Mcleod, 1987, as cited in Colorado Department of Public Health and the Environment, 2005, found a relationship between bed material size and macroinvertebrate habitat availability, and also found that excessive sediment decreases the diversity and density of macroinvertebrates. If sediments are carried downstream into brackish and salt waters, it can degrade the health of oyster beds, which are critical for water filtration and cleaning in the Chesapeake Bay (U.S. Geological Survey and U.S Department of the Interior 2003; Cerco & Noel 2005).

Another way that sediments can damage the health of aquatic communities is by transporting pollutants into the watershed. Nutrients and metals can form complexes with minerals found in fine sediment, consequently, water runoff not only carries excessive sediments, but often includes pollutants as it washes into waterways. Excess of certain nutrients and minerals can be toxic to many aquatic organisms (Nelson and Booth 2002). For example, excess phosphorus in the water increases the growth of surface level algae. The algae can block out sunlight and prevent it from getting to the submerged aquatic vegetation (SAV), which is an essential part of the aquatic food chain. Excessive algae growth also uses up oxygen in the water and can create hypoxic conditions, meaning that the dissolved oxygen level is too low to support many aquatic organisms. See USGS Summary Report on Sediment Processes: Executive Summary.

This section will describe the watershed characteristics of the Baltimore County portion of the Jones Falls watershed. Section 5.1 has general characterization information and Section 5.2 discusses land use, sediment loads and reductions and the total reduction required to meet the TMDL. Characterizing the watershed can aid planning and restoration targeting efforts and improve understanding of sediment sources. Note that all references to the Jones Falls watershed are referring to the Baltimore County portion of the watershed only.

The TMDL document produced by MDE used 2002 as the baseline year for data in determining the sediment load reduction required (Maryland Department of theEnvironment 2009). Figure 5.1 shows the Jones Falls watershed.

5.1 General Information

5.1.1 Acreage

The Baltimore County portion of the Jones Falls watershed contains 25,933 acres of land with varying usages and pollution potential.

5.1.2 Population

Population data provides another way to evaluate the intensity of land use. Much of the degradation from urban/suburban land uses (where population is mainly concentrated) is related to the extent of impervious cover and also conversion of land uses that protect water resources such as forest. A higher population density (persons per acre) represents a more intense use of the land and potential for environmental degradation.

Census block data from the 2000 US Census and 2010 US Census was used to determine the population in the watershed. Data from the 2000 US Census was interpolated in order to estimate the population for 2004, which is the baseline year for the TMDL and therefore important to understand the conditions at the time the TMDL was developed. Population for 2002 and 2010, and the percent change since the baseline year in the Jones Falls watershed is shown in Table 5.1.

Table 5.1: Population Data for Jones Falls Watershed (Baltimore County)

	2002	Current	% Change
Jones Falls	61,501	64,881	+5.5

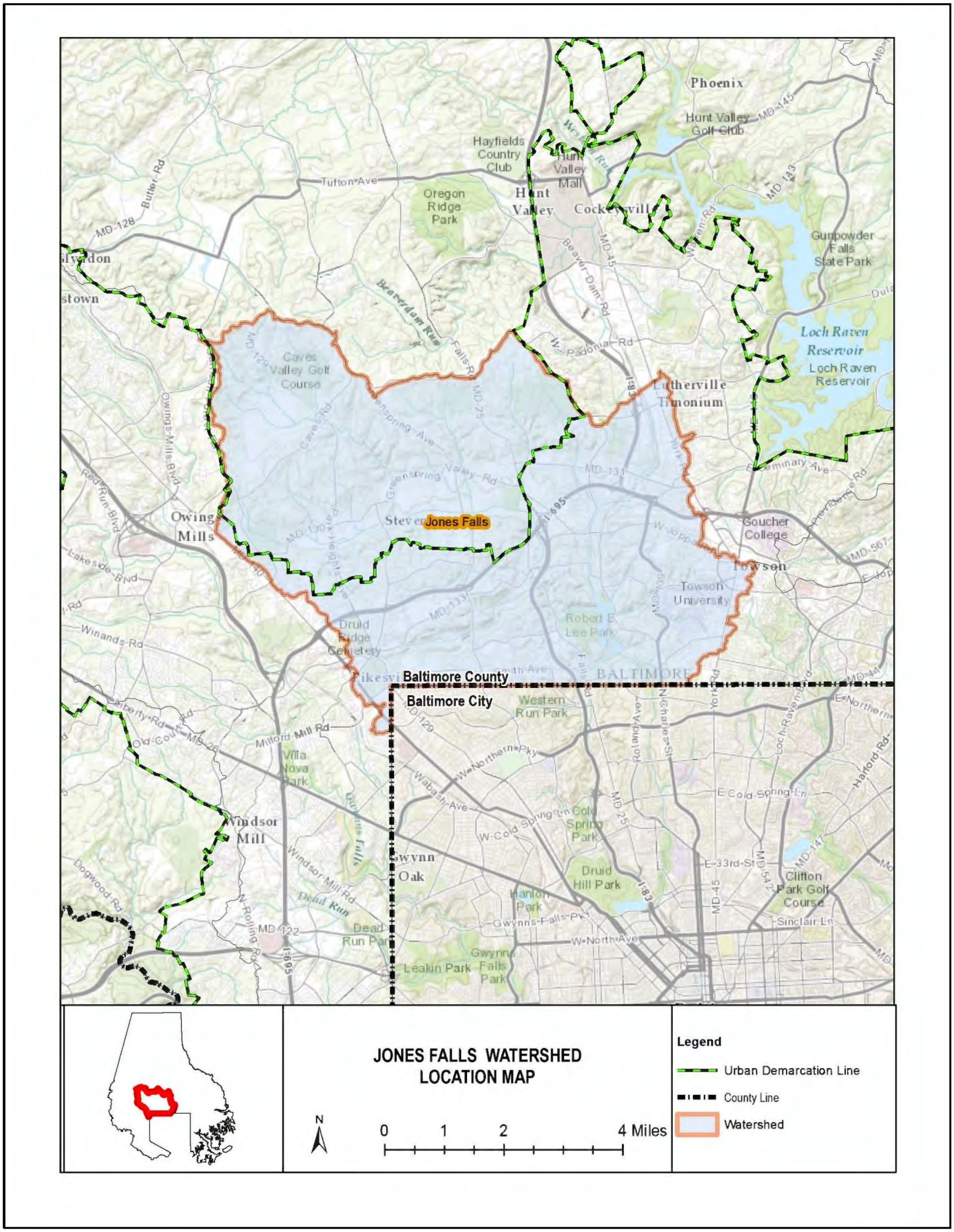

Figure 5.1: Jones Falls Watershed

5.1.3 Streams

Streams were analyzed using Geographic Information Systems. 2005 Hydrology data was queried on “SINGLE LINE STREAM” and “DOUBLE LINE STREAMS/RIVERS”. Double line streams data was divided by 2 and added to the single line stream data to calculate total stream miles. Table 5.2 shows length of streams in Jones Falls.

Table 5.2: Streams Data for the Jones Falls Watershed (Baltimore County)

Linear Feet of Stream	Miles of Stream
814,427.7	18.7

5.2 Land Use, Sediment Loads and Reductions

As mentioned above, 1997 is the baseline year for the sediment TMDL for the Jones Falls watershed. The analyses completed on sediment loads and reductions, pre and post baseline to determine the appropriate TMDL target are described below.

Due to the need to reconcile this plan with the Chesapeake Bay TMDL, a land use dataset was needed that had current data, and was also appropriate for analyzing change over time. A land use dataset was created to meet these requirements by fusing the USGS National Land Cover Database (Jin, 2013) from 2001, 2006, and 2011 with Baltimore County impervious surface data from 1995, 1996, 1997, 2001, 2005, and 2011. This land use dataset and the pollutant loading rates used for the analysis in this plan differ from the data used in the TMDL document, and therefore produced different results. Pollutant loading rates from the most recent Bay Model (Version 5.3.2) were used to calculate the loads for this plan based on land use.

Table 5.3 shows the Jones Falls sediment loads for the baseline land use and current land use broken out by all land uses. Loading rates used and shown in Table 5.3 are from the Chesapeake Bay Program’s Watershed Model Version 5.3.2, and represent edge-of-stream per acre loading rates specific to the Jones Falls watershed.

Table 5.3: Change In Jones Falls Sediment Total Loads Based on Land Use (Baltimore County)

Land Use	SED Loading Rate (lbs/ac/yr)	Acres Baseline (2004)	SED Load Baseline (lbs/yr)	Acres Current (2011)	SED Load Current (lbs/yr)	Δ in acres (acres)	Δ in SED Load (lbs/yr)
Water	0.00	73.2	0.0	82.6	0.0	9.4	0.0
Urban Pervious	132.26	9,888.2	1,307,811.3	9,747.3	1,289,173.8	-140.9	-18,637.4
Urban Impervious	968.4	3,807.1	3,686,818.0	4,131.4	4,000,830.9	324.3	314,012.9
Extractive	1,939.01	15.1	29,251.5	4.7	9,164.6	-10.4	-20,086.9
Forest	29.65	10,024.5	297,225.4	9,879.6	292,929.4	-144.9	-4,296.0
Pasture	128.65	998.9	128,510.0	956.8	123,097.0	-42.1	-5,413.0
Crop	544.96	1,126.1	613,677.7	1,130.7	616,160.9	4.6	2,483.2
Total			**6,063,293.9**		**6,331,356.7**		**268,062.8**

Note that Table 5.3 demonstrates that there was a significant increase in urban impervious coupled with a decrease in forest, urban pervious and pasture. This resulted in an overall increase in the sediment load. The 2011 load increased from 6,063,294 pounds per year to 6,331,358 pounds per year as a result of land use change ignoring any BMPs installed between 1997 and 2011. The urban load increased from 4,994,629 pounds per year to 5,290,005 pounds per year for an increase of 295,376 pounds of sediment per year. This additional load was offset somewhat by installation of BMPs as a result of development and restoration actions that occurred in the interim time period.

The Jones Falls Sediment TMDL used the Chesapeake Bay Program Phase 5 Watershed Model for the Jones Falls watershed (2 land/river segments) prior to the calibration and scenario runs. It is unclear whether the model results are a No BMP run, as is typical in establishing the baseline or whether they used a model run that had load reductions due to BMPs. The data that Baltimore County has used in this analysis is from the model run from October 2011, which was used to refine the Bay TMDL that was finalized in December 2010. The data was extracted from MAST No BMP data and land uses were subsequently analyzed by using a weighted mean for the various land uses (ie. all of the crop land uses were distilled into a single crop category).

Some restoration has already taken place, both before and after the TMDL baseline year. Pre and post baseline restoration is shown in Tables 5.4 and 5.5 respectively.

Table 5.4: Jones Falls Restoration Sediment Reductions in Baltimore County Before Baseline (2004)

Restoration Type	SED Reductions (lbs/yr)
Stormwater Management	**353,763.3**
Ba Co Restoration Projects	270,600.6
Watershed Group Buffer Plantings	0.0
Watershed Group Upland Plantings	0.0
Watershed Group Disconnections	0.0
Ba Co Rain Barrel Sales	0.0
Ba Co Tree Planting	0.0
Total (lbs/yr)	**624,363.9**

Table 5.5: Jones Falls Restoration Total Sediment Reductions

Restoration Type	SED Reductions (lbs/yr)
Stormwater Management	**551,225.8**
Ba Co Restoration Projects	439,925.5
Watershed Group Buffer Plantings	1,645.0
Watershed Group Upland Plantings	1,217.9
Watershed Group Disconnections	2,049.2
Ba Co Rain Barrel Sales	1,704.1
Ba Co Tree Planting	547.0
Total (lbs/yr)	**998,314.5**

Baltimore County is charged with addressing pollutant loads from urban land. Table 5.6 shows only the urban land uses and their associated loads. Also shown in Table 5.6 are the restoration reductions prior to the baseline year and up to the current year from Tables 5.4 and 5.5. The total sediment load after these reductions are applied is also shown in Table 5.6.

Table 5.6: Change In Jones Falls Sediment Urban Loads Based on Land Use (Baltimore County), Development BMPs, and Restoration Actions

Land Use	SED Loading Rate (lbs/ac/yr)	Acres Baseline (1997)	SED Load Baseline (lbs/yr)	Acres Current (2011)	SED Load Current (lbs/yr)	Δ in SED Load Since Baseline
Urban Pervious	132.26	9,888.2	1,307,811.3	9,747.3	1,289,173.8	-18,637.4
Urban Impervious	968.4	3,807.1	3,686,818.0	4,131.4	4,000,830.9	314,012.9
Total			**4,994,629.3**		**5,290,004.7**	**295,375.5**
Development Stormwater Management			-353,763.3		-551,225.8	
Restoration Reductions			-270,600.6		-447,088.7	
Total Load (lbs/yr)			**4,370,256**		**4,291,690.3**	**-78,556**
Total Load (tons/yr)			**2,185.1**		**2,145.8**	**-39.3**

Section 8 of this report has more specific details on the restoration BMPs and how their reductions shown in Tables 5.4-6 are calculated.

The baseline year in the Jones Falls Sediment TMDL document has a load of 3,922,600 pounds of sediment for the Baltimore County urban stormwater load. Table 5.6 indicates a baseline load of 4,370,256 pounds of sediment after accounting for BMPs and restoration. The MAST derived sediment load for 2010 TMDL baseline year is 5,047,656 with no BMPs. If we subtract the reductions due to development BMPs and restoration indicated above, the load would be 4,423,292 pounds of sediment. This number is closer to our estimate than the TMDL derived estimate, and because it is five years later, additional development will have occurred.

In order to determine the urban stormwater TMDL target load, the change in the urban sediment load from the TMDL baseline year (2004) (4,370,256 pounds) to the end of fiscal year 2013 was calculated and is shown in Table 5.6 (-78,556 pounds/yr).

The percent reduction required to meet the TMDL for Baltimore County urban land is 21.9% from the baseline load (MDE, MDE TMDL Data Center WLA Search 2014). However, since the baseline year, the total sediment load in the watershed has increased due to changes in land use, but decreased due to the installation of development BMPs and the restoration work that the County has undertaken. This decrease in load (78,556 pounds/yr) was subtracted from the reduction required from the baseline. Table 5.7 shows the sediment load reductions needed (878,530 pounds) to meet the Baltimore County urban land TMDL reductions.

Table 5.7: Sediment Reduction Required to meet TMDL (Baltimore County Urban Land)

Baseline SED Load (pounds)	Current SED Load (pounds)	% Reduction Required From Baseline % Reduction	SED Reduction Required From Baseline (pounds/yr)	Δ in SED Load From Baseline (pounds/yr)	Total SED Reduction Required (pounds/yr)
4,370,256	4,291,690	21.9	957,086	**-78,556**	**878,530**

In order to meet the requirements of the TMDL, BMPs must be installed to reduce 878,530 pounds of sediment per year. Section 9 of this TMDL Implementation Plan details how Baltimore County can meet this urban allocation of the Jones Falls sediment TMDL. Most BMPs have a cumulative effect, meaning a one-time installation results in pollutant reduction year after year for the life of the BMP.

The Baltimore County trend program provides ambient water quality sediment data for the Jones Falls. Baltimore County trend data is presented in Section 6.1. Section 6.2 Uses DNR and Baltimore County Benthic Index of Biological Integrity (BIBI) data to see if the TMDL water quality standard is being achieved. Baltimore County had a baseflow program but that data is not applicable to the TMDL. The baseflow program sampled dry weather flows only and this is representative of only a small part of the total suspended sediment load. Sites can be seen in Figure 6.1.

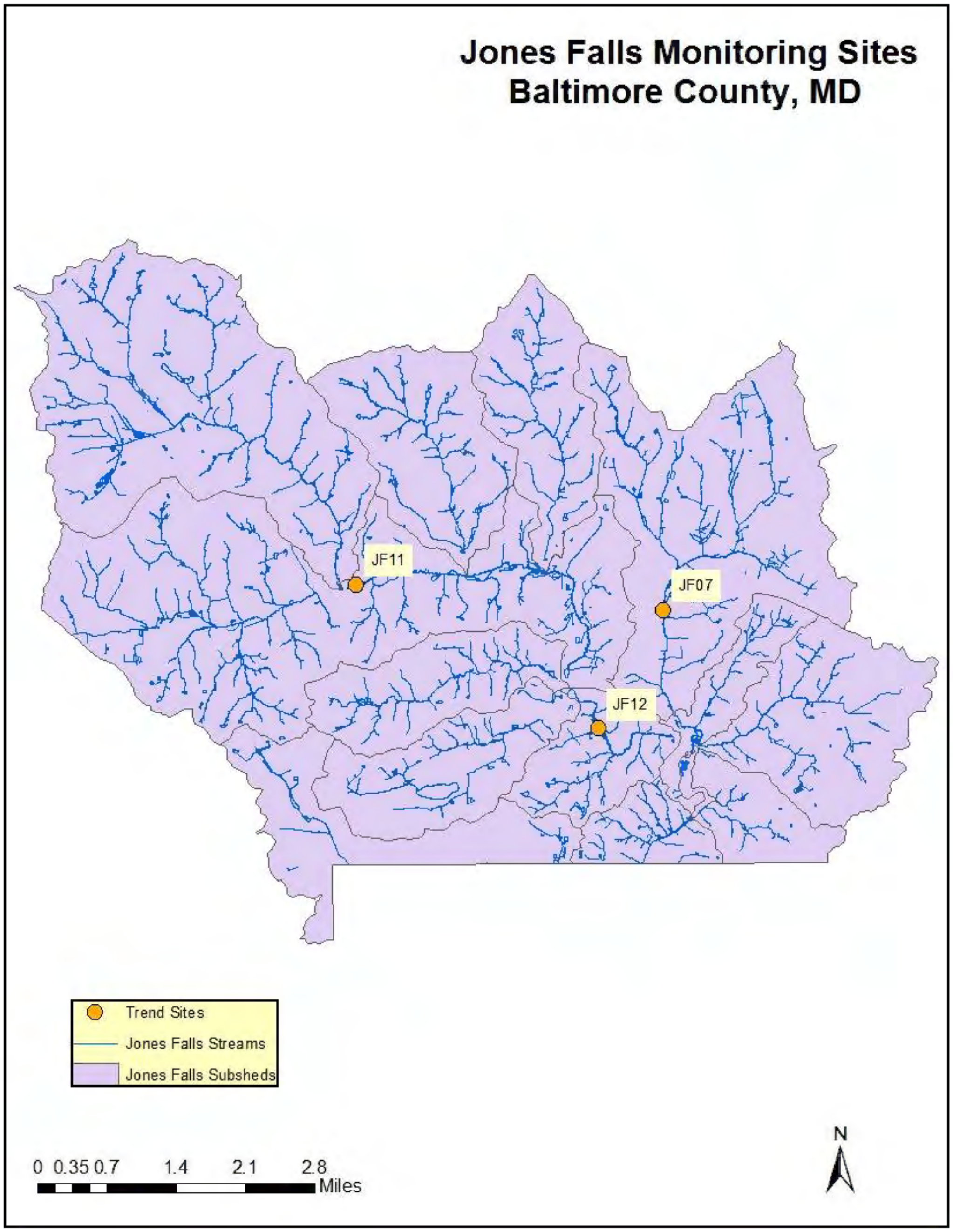

Figure 6.1: Chemical Monitoring Locations in Jones Falls Watershed

6.1 Baltimore County Data

In January 2011, Baltimore County's baseflow monitoring program was replaced with a water quality trend monitoring program. The trend monitoring program observes ambient chemical conditions and determines trends in chemical concentrations and pollutant loads over time at forty-one sites. This data is used to determine areas to target restoration, assess the impact of implemented restoration activities, and determine the amount of progress made towards meeting TMDLs and other restoration goals. The sites are broken into four sampling days which remain the same each month regardless of weather. Three of those trend sites were within the Jones Falls watershed (Figure 6.1):

1. JF07 (3,011 acres) which is located on Roland Run at Joppa Road;
2. JF11 (7,941 acres) which is located on Jones Falls at Hillside Road;
3. JF12 (15,997 acres) which is located on Jones Falls at Falls Road.

Site JF12 and USGS gage 01589440 are at the same location. The USGS gage provides real-time flow data which is used in the load calculations. The gage data can be found at: http://waterdata.usgs.gov/usa/nwis/uv?01589440.

The chemical results from the trend monitoring were analyzed in conjunction with the discharge data. Both the chemical and the discharge data were $\log_{10}$ transformed before regression analysis. The regression equations were used to calculate the chemical concentrations for each 15 or 5-minute interval for recorded discharge (equation 6.1).

$$\mathbf{P_L = (P_C x.000008345)x(CFSx448.8x1440),} \qquad \mathbf{(6.1)}$$

Where:

P_L = Pollutant Load,
P_C = Pollutant Concentration,
.000008345 = Conversion factor to convert mg/L to pounds per gallon,
CFS = Cubic feet per second,
448.8 = Conversion factor to convert cubic feet per second to gallons per minute
1440 = number of minutes in one day

The result of the above equation is in lbs/day of pollutant, which can then be divided by the number of acres in the drainage area to derive the lbs/acre/day load. The flow is the average for the year of cfs at time of sampling.

6.1.1 Summary of Data Results

Water quality parameters measured as part of the County's trend monitoring program include Total Suspended Sediment (TSS).

Table 6.1: Average Baltimore County Trend Sampling Results

Site	Date	N	Average Daily Flow (cfs)	Annual TSS (lbs)	TSS (lbs/acre/day)
JF07	2011	12	8.8	76,319.5	0.0694
JF07	2012	12	6.8	56,629.1	0.0515
JF07	2013	12	6.2	44,609.1	0.0406
JF07 Average			7.3	59,185.9	0.0539
JF11	2011	12	11.9	45,599.0	0.0157
JF11	2012	12	11.6	41,589.4	0.0143
JF11	2013	12	12.3	43,616.2	0.0150
JF11 Average			11.9	43,601.5	0.0150
JF12	2011	12	46.7	13,590,375.9	2.3276
JF12	2012	12	37.8	8,462,642.2	1.4494
JF12	2013	11	33.0	1,583,196.3	0.2711
JF12 Average			39.2	7,878,738.2	1.3494

Figure 6.2 graphically shows TSS lbs/acre/day at the eleven trend monitoring program sites over the years.

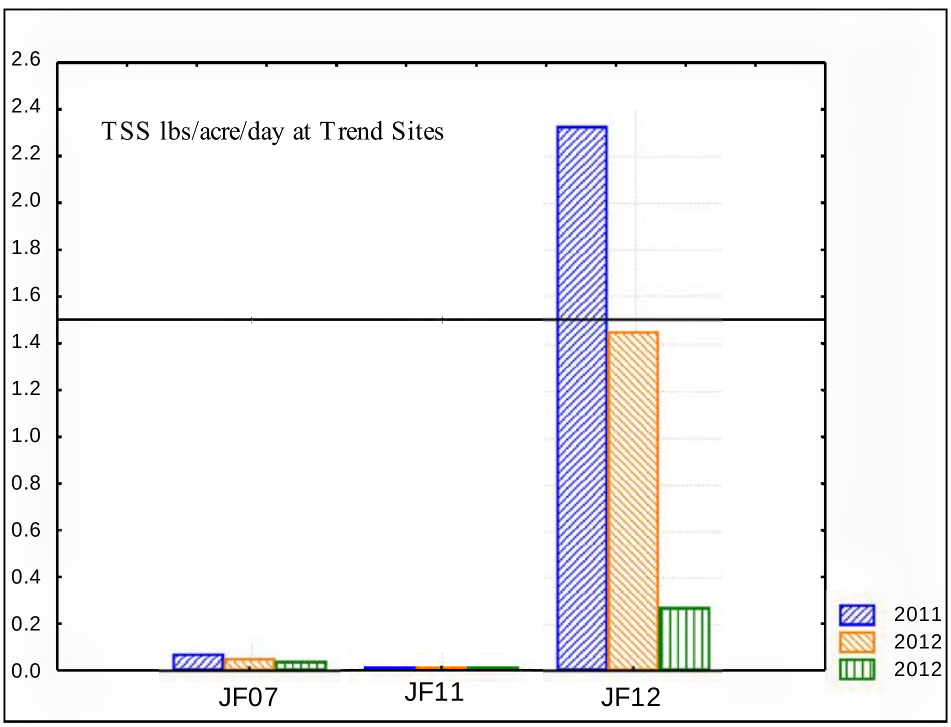

Figure 6.2: TSS lbs/acre/day at Baltimore County Trend Monitoring Sites

6.1.2 *Comparison of Data to TMDL Targets*

The TMDL target of 01.50 lbs/acre/day was reached at all sites except JF12 in 2011.

6.2 Comparison of Data to TMDL Water Quality Standard: Benthic Index of Biological Integrity

Baltimore County conducts biological monitoring of benthic macroinvertebrates on an annual basis using the Maryland Biological Stream Survey (MBSS) protocols (Kazyak 2001, Stranko 2010). The MBSS is a random design stream sampling program that was initiated by the Maryland DNR in 1993. It is intended to provide unbiased, statewide estimates of the biological resources in streams and rivers.

Benthic macroinvertebrates are organisms without a backbone that live on the bottom of streams and can be seen with the naked eye. They are an important part of stream ecosystems as they are a source of food for other aquatic life, including fish. The presence, numbers, and types of benthic macroinvertebrates also convey information about a waterbody's quality. Results of the MBSS protocol include a BIBI score based on the benthic community at a sampling site. Qualitative ratings of stream Biological Integrity are based on IBI scores and range from good (4.0 – 5.0), denoting minimally impacted conditions, to very poor (1.0 – 1.9), indicating severe degradation.

6.2.1 *Biological Data from Baltimore County*

Sites for the Baltimore County biological sampling program are randomly selected, focusing on the Patapsco/Back River Basin in odd years and the Gunpowder/Deer Creek Basin in even years. Between 2003 and 2011, 124 sites were randomly sampled in the Jones Falls watershed by Baltimore County. Figure 6-3 shows the monitoring sites, as well as their BIBI narrative ratings. The overall average BIBI score was 2.74 (Poor) with 57 sites having scores above a rating of 3.00 and 67 sites having scores of Poor and Very Poor.

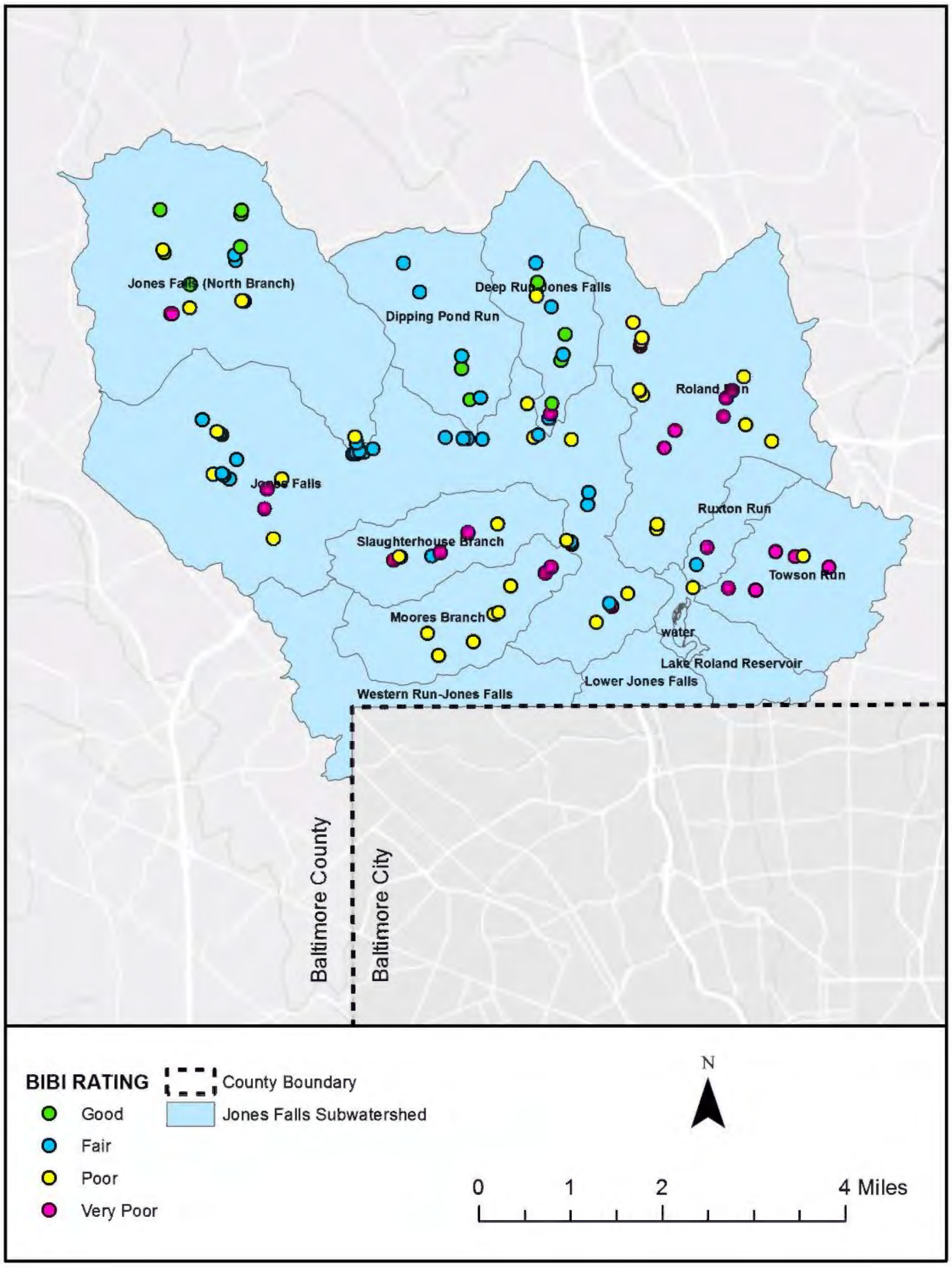

Figure 6.3: Locations of Biological Monitoring Sampled by Baltimore County in the Jones Falls Watershed and Results of Benthic Macroinvertebrate Monitoring, 2003-2011

6.2.2 Maryland Department of Natural Resources Data

The MBSS was started by the Maryland Department of Natural Resources in 1993 as a small pilot study and expanded statewide by 1994. Round 1 of the sampling started in 1995 with the completion of Round 3 in 2009. The MBSS was Maryland's first probability-based or random design stream sampling program intended to provide unbiased estimates of stream conditions with known precision at various spatial scales ranging from large 6-digit river basins and medium-sized 8-digit watersheds to the entire state. In addition to data collected by the County, Maryland DNR sampled forty three random sites in the Jones Falls watershed through the MBSS program (Figure 6.4). The DNR data tends to be higher in BIBI scores in comparison with the County data, with an average BIBI score of 3.66. Of the 43 sites, 33 had a rating of Fair or above with only 10 sites having a rating of Poor and Very Poor.

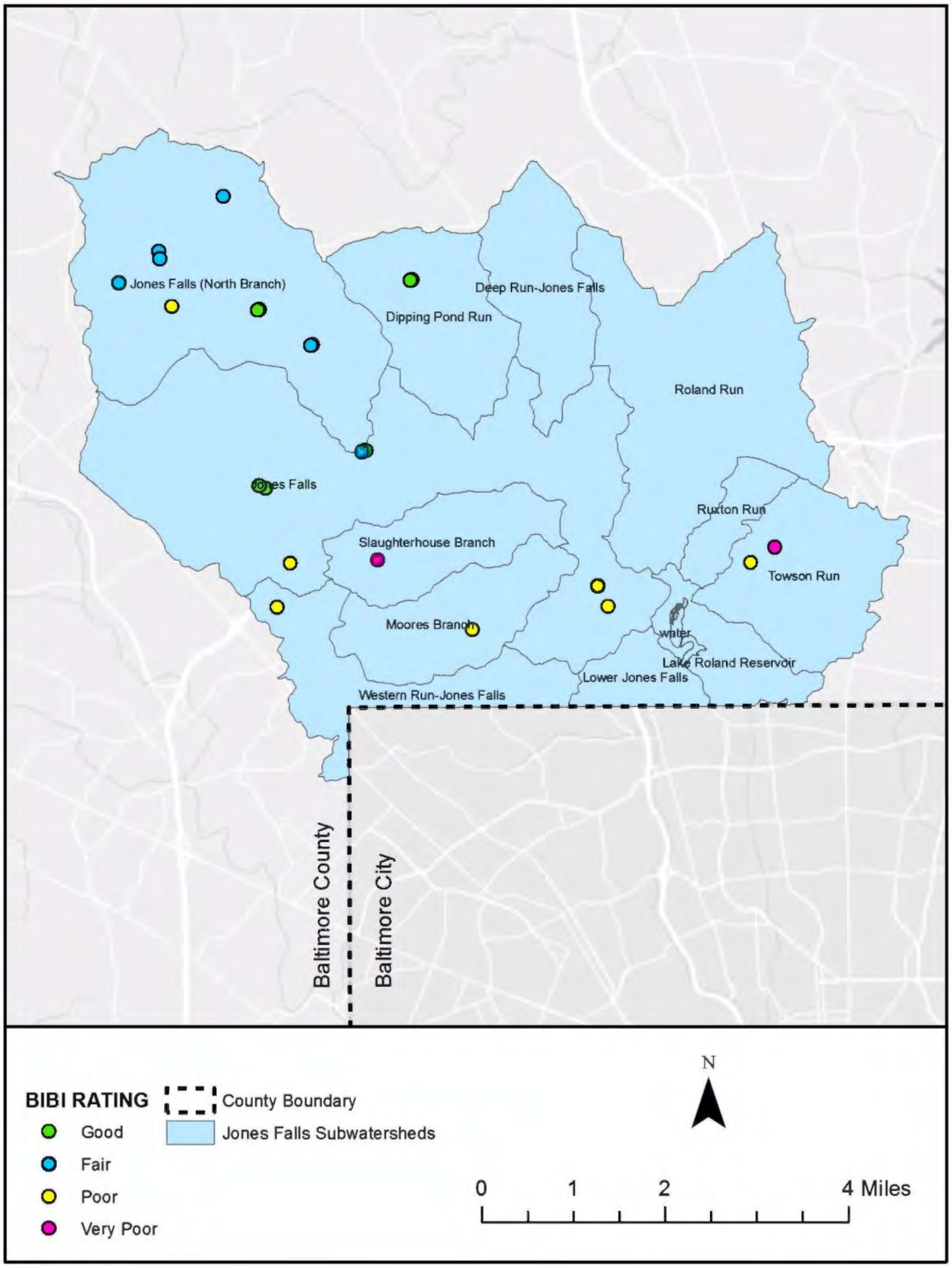

Figure 6.4: Locations of Maryland Biological Stream Survey Locations in the Jones Falls Watershed and Results of Benthic Macroinvertebrate Monitoring, 1995-2011

6.2.3 Summary of Data by Subwatershed

The Baltimore County portion of the Jones Falls watershed is comprised of 12 subwatersheds, two of which there is no BIBI data present (Lake Roland Reservoir, and Lower Jones Falls). Combining the BIBI data collected by Baltimore County and the MBSS Program provides thirteen years of data, which offers a better understanding of the impairment by subwatershed. Table 6.2 summarizes the BIBI data by subwatershed.

Table 6.2: Summary of BIBI Data from the Jones Falls Watershed

	Deep Run	Dipping Pond Run	Jones Falls	Jones Falls – North Branch	Moores Branch	Roland Run	Ruxton Run	Slaughterhouse Branch	Towson Run	Western Run
MBSS 1995		4.67	3.17	3.50						2.66
MBSS 1996			4.00	4.67	2.00				1.00	
MBSS 2000		4.67		5.00						
MBSS 2001		5.00		4.00						
MBSS 2002		4.00	3.78	3.75					2.33	
MBSS 2003		4.67		4.67						
BCRP 2003	3.00	3.67	3.10	3.13	2.11	2.28	2.78	2.61	2.33	
MBSS 2004		4.00		4.00						
MBSS 2005		4.67		5.00						
BCRP 2005	3.50		3.07		1.83	2.25		2.84	1.50	2.00
MBSS 2006		3.67		4.00						
BCRP 2007	2.00	3.89	2.81	3.46	1.50	1.89		2.33	1.33	
MBSS 2007		3.67		3.17						
MBSS 2008		3.67	2.00	3.33				1.33		
MBSS 2009		4.00		2.33						
BCRP 2009	3.67	3.83	2.83	3.00	2.08	1.67		1.83		
BCRP 2011	3.60	3.67	3.00	3.00	1.89	1.44		3.00		
Mean BIBI	3.15	4.12	3.08	3.75	1.90	1.91	2.78	2.32	1.70	2.33

Four subwatersheds are meeting the aquatic biological community standards, and may not require sediment reductions, while the remaining six subwatersheds will require sediment reductions to meet the standards.

Section 7 - Summary of Existing Restoration Plans

Baltimore County has already developed management plans that aim to remove certain pollutants in parts of the Jones Falls watershed. Section 7.1 is a brief summary of the Northeastern Jones Falls Small Watershed Action Plan (SWAP). Section 7.2 is a brief overview of the Lower Jones Falls SWAP and section 7.3 is a description of the Jones Falls Watershed Management Plan. SWAPs include local based goals and objectives that are beyond the scope of the TMDL IP. All completed SWAP documents and their appendices are available online. Past studies, including these SWAPs and the Watershed Management Plan, were used to inform the Implementation Plan. The following subsections provide more specific information for each plan within the Jones Falls watershed.

7.1 Northeastern Jones Falls Small Watershed Action Plan, 2012

The *Northeastern Jones Falls SWAP* addresses a 10.9 square mile portion of the Jones Falls watershed, making up the north eastern part of the Jones Falls watershed that is within Baltimore County. Northeastern Jones Falls includes the four sub-watersheds: Roland Run, Ruxton Run, Towson Run, and the Lake Roland Direct Drainage. The Northeastern Jones falls represents 19% of the entire Jones Falls watershed.

The SWAP is a strategy for restoring the Northeastern Jones Falls. It was developed, in 2012, by Baltimore County Department of Environmental Protection and Sustainability with extensive input from county citizens, county agencies, members of watershed associations, and various institutions. The action plan outlines recommendations for watershed restoration, describes management strategies for each of the four sub watersheds, and identifies priority projects for implementation. The plan also includes cost estimates for certain potential actions and a schedule for implementation over a 13 year timeline. Financial and technical partners are suggested for implementation of various potential actions.

7.1.1 SWAP Vision and Goals

Northeastern Jones Falls SWAP Vision:

The Northeastern Jones Falls Steering Committee adopted the following vision statement that served as a guide in the development of the SWAP:

We envision a healthy, vibrant Northeastern Jones Falls watershed, which protects high quality streams and is supportive of diverse aquatic life. Our watershed conserves treasured natural resources and maintains and celebrates our residential character and landscape for today and for future generations.

Northeastern Jones Falls SWAP Goals:

- Goal 1: Improve and Maintain Clean Water
- Goal 2: Enhance Stream Riparian Corridors for Water Quality and Habitat Value
- Goal 3: Increase Citizen Participation with Restoration Projects
- Goal 4: Encourage Collaboration with the Institutional Landowners and Baltimore County EPS on Restoration Projects
- Goal 5: Enhance Natural Resources on Public Property
- Goal 6: Maintain the Residential Character of the Watershed

7.2 Lower Jones Falls Watershed Small Watershed Action Plan, 2008

The *Lower Jones Falls SWAP* addresses the southern portion of the Jones Falls watershed, including the area that crosses over into Baltimore City. The area includes six sub-watersheds and makes up 45% of the Jones Falls watershed. The Lower Jones falls is 25.9 square miles of the entire 58 square miles of the Jones Falls watershed.

This small watershed action plan was developed by a partnership between Baltimore County, Baltimore City, the Herring Run and Jones Falls Watershed Associations, and the Center for Watershed Protection Inc. The plan presents results of a thorough watershed assessment by sub-watershed, conceptual storm water retrofit project plans, overall watershed recommendations, and a draft schedule for implementation with anticipated benefits of implementation.

7.2.1 SWAP Goals

The stakeholder meetings resulted in the following set of goals to guide recommendations for the lower Jones Falls SWAP:

- Goal 1: Improve conditions in stream to achieve standards of swimmable, fishable, and water contact recreation in streams by 2022.
- Goal 2: Improve the condition of the biology in the stream by planting more stream buffers along streams and removing concrete stream channels.
- Goal 3: Implement effective watershed education.
- Goal 4: Increase the involvement of the population
- Goal 5: Disconnect impervious surfaces from the storm drain system
- Goal 6: Integrate stormwater and watershed planning goals in new and redevelopment.
- Goal 7: Continue collaboration between Baltimore City/County, watershed groups and citizens.
- Goal 8: Engage the business community in restoration
- Goal 9: Improve management of natural and turf areas

7.3 Jones Falls Watershed Management Plan (1998)

The WQMP for Jones Falls is a document that details Capital Improvement Projects (CIPs) that the County could consider to improve water quality. These Management Plans focused on County-specific actions, and not citizen-based initiatives. The plans outlined in the WQMP may be useful for determining CIPs that the County may still implement through this plan and in the future. The SWAPs include some additional CIPs along with various citizen-based plans that can reinforce the efforts of the County. The full plan is available for review at the EPS offices at 111 W. Chesapeake Ave. Towson, MD 21204.

This Best Management Practice (BMP) efficiencies section will provide basic information on each BMP capable of reducing sediment in the Jones Falls and approved as such by the Chesapeake Bay Program (CBP). This section provides an overview of pollutant reduction measures and their predicted effectiveness. This overview is meant to serve as a guide to aid in selecting the most efficient possible BMPs that may be implemented to meet the pollutant reduction goals required by the TMDL. This review utilizes conservative estimates of BMP efficiency for planning purposes, as exact types of BMPs (e.g. structural BMPs) will not be chosen until appropriate on-site analysis is complete. It is possible that only some of the listed actions in this section will be selected for inclusion in Section 9 of this Implementation Plan

8.1 BMP Descriptions

Listed and briefly described below are the approved BMPs for reducing sediment that are applicable to the Jones Falls. Most definitions were obtained from the Excel sheet *BmpDefinitions 5_15_2014.xlsx* from the MAST website: http://www.mastonline.org/Documentation.aspx (D. E. MDE 2014). Many of these practices are representative of one of many types of Stormwater Management (SWM) retrofits or conversions. A retrofit is a SWM feature that is installed in an area that has already been developed, but has minimal or no SWM treatment practices currently in place. A conversion uses an existing, older practice that may only provide water *quantity* treatment, and alters it so that water *quality* may be improved as well.

8.1.1 Dry Detention Ponds

Dry Detention Ponds are depressions or basins created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms.

8.1.2 Hydrodynamic Structures

Hydrodynamic Structures are devices designed to improve quality of stormwater using features such as swirl concentrators, grit chambers, oil barriers, baffles, micropools, and absorbent pads that are designed to remove sediments, nutrients, metals, organic chemicals, or oil and grease from urban runoff.

8.1.3 Dry Extended Detention Ponds

Dry Extended Detention (ED) basins are depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. As such, they are similar in construction and function to dry detention basins, except that the duration of detention of stormwater is designed to be longer, theoretically improving treatment effectiveness.

8.1.4 Wet Ponds and Wetlands

A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal.

8.1.5 Infiltration Practices

A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration practices, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil, they are not constructed on poor soils, such as C and D soil types. Engineers are required to test the soil before approved to build is issued. To receive credit over the longer term, jurisdictions must conduct yearly inspections to determine if the basin or trench is still infiltrating runoff.

8.1.6 Filtering Practices

Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various sand filter designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require inspection and maintenance to receive pollutant reduction credit (Collins, et al. 2009).

8.1.7 Environmental Site Design

Small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources (MDE, 2000 Maryland Stormwater Design Manual 2000).

8.1.8 Street Sweeping and Inlet Cleaning

Street sweeping measured by the weight of street residue collected. Street sweeping and storm drain cleanout practices rank among the oldest practices used by communities for a variety of purposes to provide a clean and healthy environment, and more recently to comply with their National Pollutant Discharge Elimination System stormwater permits.

8.1.9 Tree Planting

Tree planting includes any tree planting, except those used to establish riparian forest buffers.

8.1.10 Urban Forest Buffers

An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water. The riparian area is managed to maintain the integrity of stream channels and shorelines, to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals.

8.1.11 Impervious Surface Removal

Reducing impervious surfaces to promote infiltration and percolation of runoff storm water.

8.1.12 Stream Restoration

Stream restoration in urban areas is used to restore the urban stream ecosystem by restoring the natural hydrology and landscape of a stream, help improve habitat and water quality conditions in degraded streams.

8.1.13 Redevelopment

Redevelopment consists of applying new uses to previously occupied urban space. This can sometimes involve a change in zoning or land use all together, or simply finding new uses for existing structures. In many cases this can allow for a site that previously had no water quality treatment practices to incorporate them into the new development.

Table 8.1: Pollutant Reductions of BMPs

Practice	Nitrogen	Phosphorus	Sediment	Bacteria
Dry Detention Ponds and Hydrodynamic Structures	✓	✓	✓	✓
Dry Extended Detention Ponds	✓	✓	✓	✓
Wet Ponds & Wetlands	✓	✓	✓	✓
Infiltration Practices	✓	✓	✓	✓
Filtering Practices	✓	✓	✓	✓
Environmental Site Design	✓	✓	✓	
Street Sweeping and Inlet Cleaning	✓	✓	✓	✓
Tree Planting	✓	✓	✓	
Urban Forest Buffers	✓	✓	✓	✓
Impervious Surface Removal	✓	✓	✓	
Stream Restoration	✓	✓	✓	✓
Redevelopment	✓	✓	✓	✓

Table 8-2 shows how the BMP practices listed above are credited.

Table 8.2 Sediment Reduction Efficiencies of BMPs

Practice	How Credited	Efficiency
Dry Detention Ponds and Hydrodynamic Structures	Reduction Efficiency	10%
Dry Extended Detention Ponds	Reduction Efficiency	60%
Wet Ponds & Wetlands	Reduction Efficiency	60%
Infiltration Practices	Reduction Efficiency	95%
Filtering Practices	Reduction Efficiency	80%
Environmental Site Design	Reduction Efficiency	90%
Street Sweeping and Inlet Cleaning	Load reduction (lbs) / ton of dry material	600
Tree Planting	Land use change	NA
Urban Forest Buffers	Efficiency + Land use change	50%
Impervious Surface Removal	Land use change	NA
Stream Restoration	Load reduction (lbs)/length (linear ft)	43.4
Redevelopment	Varies	Varies

8.2 BMP Calculations

Below is a description of the different types of reduction calculations used to estimate the amount of sediment removed by a BMP.

8.2.1 Reduction Efficiency Calculations

Pollutant reductions for practices with approved reduction efficiencies are calculated based on the approximate pollutant load received from the drainage area (DA) and removal efficiencies (RE) recommended by CBP for the various types of SWM faculties. The equation used to estimate sediment load reductions for a particular type of SWM facility is expressed as:

$$[LR\ (lbs/ac/yr) \times DA\ (acres)] \times RE\ (\%) \qquad (8.1)$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the above equations. The load must be calculated for each type of land use draining to the facility using the appropriate Loading Rate (LR). The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Table 8-2.

8.2.2 Land Use Change Calculations

Pollutant reductions for practices like tree planting and impervious surface removal use a land use change calculation to estimate pollutant reductions. The equation used to estimate sediment load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

$$Land\ Use\ Conversion\ (sediment) = [LR1\ (lbs/ac/yr) - LR2\ (lbs/ac/yr)] \times Area\ (acres) \qquad (8.2)$$

Pervious area reforestation for example would involve converting open pervious area to forest. Therefore, the loading rate would be reduced by a factor equal to the difference between pervious urban (LR1) and forest (LR2) loading rates used in the watershed pollutant analysis as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load would then be the reduced loading rate multiplied by the open pervious area available for reforestation.

8.3 Uncertainty and Research Needs

The sediment TMDL for Jones Falls is based on impairment of the aquatic community identified through the Maryland Biological Stream Survey monitoring. The current listings for biological impairments represent degraded biological conditions for which the stressors, or causes, are unknown. The MDE Science Services Administration (SSA) has developed a Biological Stressor Identification (BSID) analysis that uses a case-control, risk-based approach to systematically and objectively determine the predominant cause of reduced biological conditions, thus enabling the Department to most effectively direct corrective management action(s).

Data suggest that the degradation of biological communities in the Jones Falls is strongly associated with urban land use and its concomitant effects: altered hydrology and elevated levels of sulfate, chlorides, and conductivity (a measure of the presence of dissolved substances).

The results of the BSID analysis, and the probable causes and sources of the biological impairments in the Jones Falls, can be summarized as follows:

- The BSID analysis has determined that the biological communities in the Jones Falls are likely degraded due to inorganic pollutants (i.e., chlorides, conductivity, sulfate). Impacts on water quality due to conductivity, chlorides, and sulfates are dependent on prolonged exposure; future monitoring of these inorganic pollutants will help in determining the spatial and temporal extent of this impairment in the watershed. Impervious surfaces and urban runoff cause an increase in contaminant loads from point and nonpoint sources by delivering an array of inorganic pollutants to surface waters. Currently, there is a lack of monitoring data for many of these substances; therefore, additional monitoring of REVISED priority inorganic pollutants is needed to more precisely determine the specific cause(s) of impairment.

- The BSID analysis has determined that biological communities in the Jones Falls are also likely degraded due to flow/sediment related stressors. Specifically, altered hydrology and increased runoff from urban impervious surfaces have resulted in channel erosion and subsequent elevated suspended sediment transport through the watershed, which are in turn the probable causes of impacts to biological communities. The BSID results thus confirm the 2008 Category 5 listing for total suspended solids as an impairing substance in the Jones Falls, and link this pollutant to biological conditions in these waters.
- The BSID process has also determined that biological communities in the Jones Falls watershed are likely degraded due to anthropogenic channelization of stream segments. MDE considers channelization to be a form of pollution not a pollutant; therefore, a Category 5 listing for this stressor is inappropriate. However, Category 4c is for waterbody segments where the State can demonstrate that the failure to meet applicable water quality standards is a result of pollution. Category 4c listings include segments impaired due to stream channelization or the lack of adequate flow. MDE recommends a Category 4c listing for the Jones Falls watershed based on channelization being present in approximately 41% of degraded stream miles (MDE 2009).

The sediment TMDL was developed to address the degradation of the aquatic community. Meeting the sediment TMDL reduction requirements may not result in improvement of the aquatic community to fair or good conditions due to the existence of additional impairing factors for which TMDLs have yet to be developed. However, improvement of aquatic habitat and reduction of sediment is necessary component to any aquatic community improvement.

The Implementation of the TMDL is the core of this document. In this section you will find a list of actions that together become one scenario as to how the county could reach the pollutant load target. While EPS has developed this scenario, progress will be assessed on an annual basis through results of implementation actions and monitoring data. It is intended that the IP will be reviewed on a five-year cycle for potential revisions. The county takes an adaptive management approach to all watershed planning efforts.

Adaptive management is a decision process that promotes flexible decision making that be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood (U.S Department of the Interior 2009). The tools that Baltimore County will use in adaptive management are the tracking of implementation progress through the various actions proposed in the strategy in this section, identification of barriers that prevent targeted actions from occurring, and an enhanced monitoring program to measure progress in both reductions and meeting water quality standards. While this will be an on-going process, there will be a formal review of the strategy at five year intervals to determine if changes are needed or if the strategies are on track.

9.1 Implementation Actions

For this IP we will categorize the actions to be taken with respect to addressing source reduction. Implementation actions have been pulled directly from the SWAPs within the watershed area. These actions have been carefully analyzed for their projected participation rates and feasibility during the SWAP development process. Please refer to the associated SWAPs for further explanation of the scientific development process: Baltimore County SWAPS. The Lower Jones Falls SWAP is within the area of this particular implementation plan. This SWAP was written by Center for Watershed Protection as a combined SWAP for Baltimore City and Baltimore County. Approximately 30.09% of the Lower Jones Falls is within Baltimore County, therefore; this percentage has been applied to the acreages of action items from this SWAP area.

There are many actions that may be taken that would have an explicitly indirect impact on sediment, however with no ability to prove the cause/effect relationship of these actions, they will be omitted (e.g. storm drain marking).

The actions are broken out into three separate sections. Programmatic actions are actions that do not have a measureable load reduction, but create the condition necessary to reduce the pollutant. Some of these actions require a plan for program development because they are new programs that have not yet been developed by the county. Management actions are actions that require regular actions on county property. Restoration actions are new control measures aimed to reduce pollutant loads.

9.1.1 Programmatic Actions

Programmatic actions are those that do not directly result in load reductions, but create the necessary conditions for load reduction. Actions within this category might include public education and outreach activities, monitoring, or supporting specific legislation. These actions will move Baltimore County closer to achieving TMDL targets; however, there is currently no way to attribute a predictable pollutant load reduction to programmatic actions. Some programmatic actions, such as investigation and monitoring, are necessary to implement management and restoration actions or make those actions more efficient. Other programmatic actions, such as education and outreach actions, are predicted to increase the load reduction over time through BMP implementation by individual citizens. The exact load reduction is not predictable because the participation rate for individual home owners installing BMPs, as a result of public education, is not yet known. Educated citizens may support load reductions in other ways such as educating other citizens about watershed management actions, supporting legislation that improves watershed management, and other actions that do not have associated load reductions but support the necessary condition for pollutant reduction.

9.1.2 Management Actions

Management actions are those where there is regular management of county property, such as, street sweeping. It does not include the development of new control measures, such as, retrofitting highway yards. Management actions have predictable load reductions, which can be used to calculate the contribution of each action toward meeting the overall load reduction required by the TMDL.

9.1.3 Restoration Actions

Restoration actions include the development of new control measures aimed to reduce pollutant loads as well as retrofits of existing stormwater management facilities. It may include reforestation actions as well as any stormwater control measures that do not require regular management on county property. Restoration actions will have predictable load reductions, which will be used to calculate the contribution of each action toward meeting the overall load reduction required by the TMDL.

9.1.4 Implementation Actions Tables

The following tables 9.1, 9.2, and 9.3 collectively describe the actions that will be taken to reach the TMDL reduction goal as stated in the TMDL document issued by MDE. Table 9.3 describes the required reduction to meet the TMDL, which can be compared to the total projected reductions by 2025 from table 9.2.

Table 9.1: Programmatic TMDL Implementation Actions for Sediment in the Jones Falls

Programmatic Action	Time Frame	Performance Standard	Responsible Party
Programmatic Actions			
Coordinate restoration activities between and among Baltimore County and Blue Water Baltimore	On-going	Documented in NPDES Report	Baltimore County EPS, Blue Water Baltimore
Implement a unified restoration tracking system to track progress toward meeting TMDL reduction requirements	2 years	None	Jones Falls SWAP Implementation Committee
Monitoring Actions			
Continue Random Point Biological Monitoring Program	On-going	Benthic macro-invertebrate samples collected in odd calendar years	EPS
Institute Subwatershed Biological Condition Program	Start 2015 – continue until BIBI standards are met	Benthic macro-invertebrate samples collected every third year	EPS
Continue Chemical Trend Monitoring Program	On-going	Samples collected yearly	EPS

Programmatic Action	Time Frame	Performance Standard	Responsible Party
Programmatic Actions			
Explore feasibility of installing turbidity meters	2- years	Feasibility report generated, if feasible, monitoring plan developed	EPS
Reporting Actions			
Jones Falls SWAP Implementation Committee to meet on a semi-annual basis to discuss implementation progress and assess any changes needed to meet the goals.	20 years	2 meetings per year	EPS and Implementation Committee partners
Continue to update status of restoration projects and BMPs in the Annual MS4 Report.	Annually	MS4 Report submitted to MDE and posted on county website	EPS
Implement the Continuing Public Outreach Plan	On-going	Number of actions per year	EPS
Hold Biennial State of Our Watersheds Conference in even years	Biennially	Conference Held	EPS
Adaptive Management assessment of the Implementation Plan	5 year interval	Assessment complete	EPS

The following pollutant load reductions were calculated using accepted loading rates for land uses in this watershed, coupled with expected percentages of reduction as discussed in Section 8 of this Implementation Plan.

Table 9.2: TMDL Implementation Actions with Measurable Load Reductions for Jones Falls Sediment

Action	Area Addressed	Time Frame	Performance Standard	Responsible Party	Projected 2025 Load Reductions
Management Actions					
Street Sweeping Existing	68.3 miles	Ongoing	Pounds removed	Baltimore County	**47,454 (lbs/yr)**
Street Sweeping Proposed	68.3 miles	Proposed Increase	Pounds Removed	Baltimore County	**47,454 (lbs/yr)**
Storm Drain Cleaning	N/A	Ongoing	Pounds removed	Baltimore County	**5,180 (lbs/yr)**
Restoration Actions					
Stream Restoration	17850 ft	10 years	Stream restoration projects completed	Baltimore County	**801,108 (lbs/year)**
Stormwater Pond Conversions	200 acres	10 years	Drainage acres converted	Baltimore County	**46,853 (lbs/yr)**
Stormwater Retrofits	100 acres	8 years	Retrofits completed	Baltimore County	**27,686 (lbs/yr)**

Action	Area Addressed	Time Frame	Performance Standard	Responsible Party	Projected 2025 Load Reductions
Stream Buffer Reforestation	10 acres	10 years	Acres reforested	Baltimore County, Blue Water Baltimore	**2,352 (lbs/yr)**
Upland Reforestation	25 acres	10 years	Acres planted	Blue Water Baltimore, SWAP Implementation Committee	**2,565 (lbs/yr)**
Urban Tree Canopy	1,000 trees	10 years	Acres planted	Blue Water Baltimore, SWAP Implementation Committee	**1,026 (lbs/yr)**
Redevelopment	100 acres	10 years	Acres Redeveloped	Baltimore County	**94,908 (lbs/yr)**
Downspout Disconnection	4 acres	10 years	Acres Disconnected	Baltimore County, Blue Water Baltimore, SWAP Implementation Committee	**3,486 (lbs/yr)**
Total Projected Reductions by 2025					**1,038,365 (lbs/yr)**

Table 9.3: Sediment Baseline Load and TMDL Required Reductions

Total TSS Baseline Load (lbs/year)	**4,291,690**
TSS Load Reduction Goal to Meet TMDL (lbs/year)	**878,530**

*Details on how the TMDL target and pollutant loads and reductions were calculated can be found in Section 5.2.

9.2 Interim Milestones

The reductions for sediment in the Jones Falls will have measurable milestones until the 2025 implementation goal is reached. The mean BIBI score targets are based on a target of 10% improvement every three years using the mean BIBI for the impacted watersheds of 2.03 as the starting point. Table 9.4 shows the Interim milestone goals for the Jones Falls. The 2020 target for sediment reduction is 439,265 pounds of sediment.

Table 9.4: Interim Milestones

Measure	Year					
	2017	2020	2023	2025	2026	2029
Sediment Reduction		50%		100%		
Mean BIBI Score	2.23	2.46	2.70		2.97	3.27

9.3 Reductions Discussed

The reductions in the given scenario exceed the reductions necessary for meeting the TMDL target. The extra reductions will help Baltimore County get closer to the reduction target for nitrogen in the Baltimore Harbor watershed (see the Baltimore Harbor TMDL Implementation Plan). BMPs to reduce sediment often reduce nitrogen as well, therefore, reducing sediment in the watersheds upstream of the Baltimore Harbor will improve Baltimore Harbor nitrogen reductions. The timeline to implement all of the future actions with measurable reduction extends over the next 10 years. That means that all actions will be implemented by 2025. However, it is important to understand the role of lag times in watershed management and planning. Lag time is the delay from when a pollution control action is taken to when it actually results in water quality improvements. It is the sum of time required for practices to take desired effect, time required for effect to be delivered to the water source, and time required for the waterbody to respond to the effect (Meals, Dressing and Davenport 2010). Lag times will vary depending on the watershed, the management action and the pollutant type. According to the Chesapeake Bay STAC Program Report from 2012, the lag time for sediment from source to stream in the Chesapeake Bay region is less than 1-5 years, but he lag time for sediment transport from stream to Bay is 5-100 years (Chesapeake Bay Program 2012). The report also states approximate lag times for various sediment reduction actions. The lag time for an urban sediment pond was reported to be approximately 1-3 years, while the lag time for a riparian forest was approximated at 2-10 years (Chesapeake Bay Program 2012). Given this data, it is reasonable to assume that in-stream reduction will not necessarily be measurable by 2025 when all actions will be implemented. What this means is that Baltimore County may implement all of the necessary measures to meet the TMDL reductions by 2025, as TMDL is actually a limit on the amount of pollutant that is allowed to enter the stream from upland sources, but measureable in-stream effects on water quality may take a decade or more to fully reflect the load reductions. Expectations for water quality improvement should be reasonably based on the effects of lag time.

Another factor that must be considered when forming expectations about water quality improvements is the vulnerability of the end goal to other disturbances. The water quality criterion for sediment is not a measureable load, but it is to reach a fair or good IBI score. The IBI score is a measure of the diversity of the macro-invertebrate community. Sediment is not the only threat to that community. They can also be affected by excessive nutrients, low dissolved oxygen, and other disturbances in the water. The Jones Falls watershed is also listed as impaired due to chlorides and sulfates. The biological stressor identification process also identified channelization as impairing the biological community. It is highly possible that the sediment load target will be reached, but that IBI scores could remain below fair or good condition due to other environmental factors.

The assessment of implementation progress is based on two aspects; progress in meeting programmatic, management, and restoration actions; and progress in meeting water quality standards and any interim water quality benchmarks. The assessment of progress in meeting the restoration actions; includes setting up methods of data tracking, validation of projects, and pollutant load reductions associated with the actions (10.1) and will be consistent across all TMDL Implementation Plans. The assessment of progress in meeting water quality standards and interim milestones (10.2) is the data analysis associated with the monitoring plan specific to each TMDL Implementation Plan.

10.1 Implementation Progress: Data Tracking, Validation, Load Reduction Calculation and Reporting

The Baltimore County Department of Environmental Protection and Sustainability – Watershed Management and Monitoring Section is currently preparing a document entitled *Baltimore County Method for Pollutant Load Calculations, Pollutant Load Reduction Calculations, and Impervious Area Treated*. This document will detail the data sources, data analysis (including pollutant load calculations, and pollutant load reductions calculations), validation of the practices, and reporting of progress made. It was determined that a document was needed to document how Baltimore County calculated pollutant loads and pollutant load reductions from the implementation of various best management practices, as guidance from the state and Chesapeake Bay Program continue to evolve. The document will be updated annually to account for any changes that may have occurred during the previous year. Due to the fact that implementation is being achieved through the actions of many county agencies, it was also determined that the means of data acquisition, any data manipulation, and the means of data analysis needs to be documented on an annual basis to provide consistency in the data acquisition and analysis and to document any changes in the process over time. The overall result is intended to provide transparency for the general public and users of reports on progress generated as a result of the analysis.

The Maryland Department of the Environment (MDE) has provided a guidance document for NPDES – MS4 permits entitled: *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated*. The draft document was released in June 2011, followed by a final release in August 2014. The document is intended to provide consistency among the MS4 jurisdictions in calculating baselines and reporting implementation progress. The August 2014 edition includes the Chesapeake Bay Program (CBP) recent recommendations for nutrient and sediment reductions for various practices. It is anticipated that the document will be updated on a periodic basis to reflect new information on restoration practice efficiencies in pollutant load reductions. MDE also provides guidance through its' web site, with a webpage entitled *Maryland TMDL Data Center*. This site provides guidance on the development of the TMDL Implementation Plans and is updated on a regular basis.

The CBP has developed a process whereby through the formation of Expert Panels, the scientific literature is reviewed to determine pollutant load reductions for various types of restoration practices. The Expert Panels provide reports on the load reduction calculations for the various practices, along with supporting documentation; these reports are then reviewed by a series of CBP workgroups and when approved, become the basis for pollutant load reduction credits. The completed documents are posted on the web along with a description of the process, see:

http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3 Completed reviews of restoration practices applicable to the urban sector include:

- New State Stormwater Performance Standards,
- Urban Stormwater Retrofits,
- Urban Nutrient Management,
- Urban Stream Restoration,
- Enhanced Erosion and Sediment Controls, and
- Urban Filter Strip/Stream Buffer Upgrades.

Expert Panel reports essentially complete and awaiting approval include:

- Urban Shoreline Management, and
- Illicit Discharge Elimination (Nutrient Discharges from Grey Infrastructure).

Expert Panel reports developing recommendations include:

- Street Sweeping (including catch-basin clean outs and bulk sediment removal),
- Floating wetlands,
- Urban Tree Planting/Expanded Tree Canopy, and
- Riparian Forest Buffers.

In addition, to the changes in the pollutant removal efficiencies, the CBP is in the process of developing the next phase of the Watershed Model (Phase 6) to be used in the mid-point assessment to determine progress being made for the Chesapeake Bay TMDL. There will likely be changes in the land use categories designed to improve the model with respect to the pollutant loads associated with land use types. When the model is calibrated and run in 2017 there will likely be changes in the loads with respect to land use. This will necessitate a recalculation of the nutrient and sediment loads and the reductions associated with practices that treat the various land uses.

The document *Baltimore County Method for Pollutant Load Calculations, Pollutant Load Reduction Calculations, and Impervious Area Treated* will be posted for review and comment in the spring of 2015. It will be modified on an annual basis to take into account any future Expert Panel documents, modifications to any guidance documents and future calculations will reference the edition on which the calculations were based.

10.1.1 Reporting

Baltimore County will prepare two-year milestones for each local TMDL in conformance with the Chesapeake Bay TMDL two-year milestone process. Programmatic actions and monitoring data analysis will be based on the calendar year, while restoration actions will be based on the fiscal year (July 1 – June 30). The current two-year milestone period was developed in January 2014; for Programmatic actions covers January 2014 through December 2015, and for restoration actions cover July 1, 2013 through June 30, 2015. When the next two-year milestones are developed in 2016, they will be presented by watershed and will include each of the local TMDLs.

Reporting will be done through the annual NPDES – MS4 Permit Report. This is technically due on the anniversary date of the permit renewal, but will be completed for submittal to MDE in October each year. The report will detail progress made in meeting each of the local TMDLs and the Chesapeake Bay TMDL. The analysis will include progress in meeting the two-year milestone programmatic and restoration actions, along with the calculated load reduction. It will also present the results of the monitoring conducted the previous year. See below for TMDL specific monitoring.

In January of each year, a progress report (mostly extracted from the MS4 report) will be prepared and posted on the web.

10.2 Implementation Progress: Water Quality Monitoring

The rational for the development of the Jones Falls Sediment TMDL was the impairment of the aquatic biological community with sediment identified as a stressor of the biological through the Biostressor analysis conducted on the biological data, and associated data collected as part of the Maryland Biological Stream Survey (MSBB). The Biostressor analysis also indicated that chlorides, sulfates, conductivity, and channelization are impacting the aquatic biological community. These additional stressors will have to be taken into account when determining whether actions taken to address the sediment TMDL have met the aquatic biological community water quality end point.

The Jones Falls monitoring to address the sediment impairment of the biological community will mainly focus on biological monitoring (10.2.1) to assess the progress in meeting the biological water quality standard. The Chemical Trend Monitoring Program will continue at the three existing sites within Jones Falls, along with additional targeted chemical monitoring (10.2.2) and the installation of continuous recording turbidity meters will be explored (10.2.3).

10.2.1 Biological Monitoring

The Random Point Biological Monitoring Program will continue with monitoring in the Jones Falls conducted in odd calendar years. While this will provide a continuity of data that has been collected since 2003, it will not provide sufficient data to determine progress in meeting the biological community standards on a subwatershed basis. To make this determination, Baltimore County will develop a new biological monitoring program entitled, *Subwatershed Biological Condition Monitoring Program*. This program will target one watershed per year that has a TMDL associated with aquatic biological community impairment. Currently there are three watersheds that have TMDLs associated with aquatic biological community impairment. Therefore, the Jones Falls will be sampled every third year. If additional TMDLs associated with aquatic biological community impairment are developed in other watersheds, then the schedule will be adjusted accordingly.

This Subwatershed Biological Condition Monitoring Program will monitor every subwatershed within the impaired watershed or a subset depending on the results of the TMDL analysis. The Jones Falls Sediment TMDL, indicated impairment of the aquatic biological community throughout the watershed. The analysis of the biological data for the Baltimore County portion of the Jones Falls watershed (Section 6, 6.2) found that 8 or 12 subwatersheds were below the aquatic biological community water quality standard with a BIBI score less than 3.0 or no data. Baltimore County will continue monitor all 12 subwatersheds through the Random Point Biological Monitoring Program. Only the 8 subwatersheds indicating impairment will be monitored through the Subwatershed Biological Condition Monitoring Program.

A stratified random design will be used, where one random site will be sampled for each 500 acres within the subwatershed, rounded to the nearest 500 acres; with at least one sample per subwatershed. Table 10.1 presents the subwatersheds, their associated acreages, the number of samples and the current condition of the subwatershed determined by past monitoring. Thus Moores Branch with 1,397 acres of drainage area will have 3 samples, Ruxton Run with 422 acres of drainage will have 1 sample, and Roland Run with 3,822 acres of drainage will have 7 samples. Using Maryland Biological Stream Survey (MBSS) methods benthic macroinvertebrate community will be sampled during the spring index period beginning in 2017 and every three years thereafter. The results will be compared to the current condition to assess changes in the subwatershed condition.

Table 10.1: Jones Falls Subwatershed Biological Monitoring – Acres, # of Random Samples and Current Condition

Subwatershed	Acres	# of Random Samples	Current Condition		
			N	BIBI	Status
Deep Run	1,437	RP Only*	5	3.15	Fair
Dipping Pond Run	1,758	RP Only*	15	4.12	Good
Jones Falls (mainstem)	6,535	RP Only*	9	3.08	Fair
Jones Falls – North Branch	4,545	RP Only*	16	3.75	Fair
Moores Branch	1,397	3	6	1.90	Very Poor
Slaughterhouse Branch	1,273	3	6	2.32	Poor
Roland Run	3,822	7	5	1.91	Very Poor
Ruxton Run	472	1	1	2.78	Poor
Towson Run	1,848	4	5	1.70	Very Poor
Western Run	1,481	3	2	2.33	Poor
Lake Roland Direct Drainage	1,257	3	0		NA
Lower Jones Falls	536	1	0		NA

* Monitored only through the Random Point Program in odd calendar years.

10.2.2 Chemical Monitoring

Full chemical monitoring will continue through the Chemical Trend Monitoring Program at the three sites located within the Jones Falls (see Section 6, 6.2 for description). This program monitors TSS, chlorides, and sulfates, but does not give full coverage of all of the subwatersheds in the Jones Falls watershed. To address this deficiency, water quality samples will be collected as part of the Bacteria Subwatershed Prioritization Monitoring Program and delivered to the Baltimore County Department of Public Works laboratory for analysis of chlorides, sulfates, and TSS. The Bacteria Subwatershed Prioritization Monitoring Program is a fixed site, fixed interval sampling program that target subwatersheds in the urban portion of the Jones Falls to identify subwatersheds with high bacteria concentrations. Those subwatersheds that are listed in Table 10.1 and are not included in the bacteria monitoring, will have locations identified for sampling during the same sampling runs.

10.2.3 Continuously Recording Turbidity Meters

Baltimore County EPS will explore the utility of deploying continuously recording turbidity meters as a surrogate means of determining TSS concentrations without having to acquire samples for analysis. Sampling all subwatersheds for TSS, other than by grab samples; is not possible. Continuously recording turbidity meters offers an alternative that may provide the needed information in a more consistent fashion. This option and any technical difficulties will be explored within two years of the acceptance of this TMDL Implementation Plan.

In order to engage the public in the TMDL implementation process this continuing public outreach plan will be implemented upon approval of this TMDL Implementation Plan. The continuing public outreach plan is applicable to all TMDL Implementation Plans that are currently being developed and those developed in the future, as well as the Trash and Litter Reduction Strategy. This continuing public outreach plan is meant to engage county agencies, environmental groups, the business community, and the general public.

11.1 County Agencies

County agencies will be engaged through two regularly scheduled NPDES Management Committee meetings per year and other agencies meetings as necessary to move implementation forward.

11.1.1 NPDES Management Committee

The NPDES Management Committee is composed of representative agencies that are involved in meeting the NPDES – MS4 Permit requirements. This committee has met irregularly in the past, generally to review information on permit requirements and other upcoming regulatory requirements, such as, the General Industrial Stormwater Discharge Permit. In the future this committee will meet twice per year and will discuss not only the NPDES – MS4 Permit requirements, but also the TMDL Implementation Plans and progress being made in meeting the implementation strategy. In order to address all components of the TMDL Implementation Plans the committee membership will be expanded to include any county agency that has some responsibility for TMDL implementation. Examples being, the County Police Department and the Department of Environmental Protection and Sustainability – Groundwater Management Section. Prior to the development of the TMDL Implementation Plans and the Trash and Litter Reduction Strategy, these agencies were not specifically engaged in NPDES – MS4 Permit activities.

The first yearly meeting will be held in January of each year. The focus of this meeting will be to review the implementation plan 2-year milestones for each plan; provide a forum for discussion of the ability to meet the implementation actions; and determine any revisions necessary to meet the interim implementation milestones set in the plan. This meeting is also the forum for discussion of data tracking and reporting to ensure that the implementation actions are properly credited.

The second yearly meeting will be held in July of each year and will provide the forum for determining data submittal for the yearly progress report on the implementation actions and the resulting load reductions. The monitoring data from the previous calendar year will be presented and contrasted with the interim water quality milestones that are detailed in each implementation plan.

11.1.2 Other Agency Meetings

In order to move forward with implementation, agency meetings regarding specific implementation actions are anticipated. These will be scheduled as needed, and tracked by meeting date, attendance, TMDL Implementation Plans discussed, and topic. Meeting minutes will be reported in the Annual NPDES – MS4 Report submitted to Maryland Department of the Environment. This report is also posted on the County website for public access.

11.2 Environmental Groups

Baltimore County is currently engaged with local watershed associations through its funding of *Watershed Association Restoration Planning and Implementation Grants*, and through inclusion of watershed association members on the Steering Committees of the Small Watershed Action Plans. Formerly, this engagement and support was coordinated through the *Baltimore Watershed Agreement*. As part of that engagement, periodic Watershed Advisory Group (WAG) meetings were held. As part of this continuing public outreach plan, WAG participation will be formalized with two meetings per year.

The first meeting will be held in March of each year and focus on the local and Chesapeake Bay TMDL implementation actions and implementation progress, including an analysis of the pollutant load reduction calculations from the previous fiscal year. The watershed associations are currently engaged in citizen-based restoration activities and report their implementation progress to the county for inclusion in the Annual NPDES – MS4 Report. This meeting will provide a forum for discussion of the progress being made, coordination between the watershed associations, and any changes to the *Watershed Association Restoration Planning and Implementation Grant* being considered for the next grant period.

The second meeting will be held in November of each year and will focus on the water quality monitoring results from the previous calendar year. The results presented will compare trends and measures against the TMDL Implementation Plans water quality benchmarks and water quality standards.

11.3 Business Community

The business community will be engaged through various business forums, targeted outreach and education efforts on specific topics, and hosting workshops on specific topics as necessary.

11.3.1 Business Forums

Business forums, such as the Hunt Valley Business Forum with greater than 200 business members, provide opportunities to present the TMDL Implementation Plans and the Trash and Litter Reduction Strategy, and discuss the role of business in helping improve water quality. These forums will be convened as the opportunities arise. Summaries of these meetings will be reported in the annual NPDES – MS4 Report and will include the name of the forum (or other business organization), approximate number in attendance, the topic presented, and audience responses.

11.3.2 Targeted Business Outreach and Education

The Small Watershed Action Plan (SWAP) process includes an upland assessment of potential pollution hotspots. Often, these potential hotspots are commercial or industrial sites. The information derived from this assessment will be used to target outreach and education to businesses specific to the issue(s) at the location identified in each SWAP. These actions will be tracked and reported in the annual NPDES – MS4 Report.

11.3.3 Business Workshops

There are certain issues that may be pervasive through a segment of the business community that can most effectively be addressed through hosting workshop education on the specific topic. These issues will be identified as SWAP implementation moves forward, but one potential topic for a business workshop is related to the recently renewed *General Discharge Permit for*

Stormwater Associated with Industrial Activities. A workshop designed in conjunction with Maryland Department of the Environment would not only result in improved water quality, but it would also benefit the business community through increased understanding of the requirements of the permit.

11.4 General Public

The general public will be engaged through a number of mechanisms, including:

- WIP Team meetings
- Targeted outreach and education efforts on specific topics
- Steering Committee meetings and stakeholder meetings in the development of Small Watershed Action Plans
- Meetings of the Implementation Committee for completed Small Watershed Action Plans
- Displays at various events
- Annual progress reports posted on the county website and placed in our libraries
- A biennial *State of Our Watersheds* conference.

11.4.1 Watershed Implementation Plan (WIP) Team Meetings

Baltimore County has assembled a WIP team to serve as a sounding board for the development of the WIP to address the Chesapeake Bay TMDL. Members of the team include representatives from various county agencies, business community representatives (particularly the environmental engineering community), watershed associations, representatives from the agricultural community, and Baltimore County citizens.

The county will schedule at least one meeting annually to present implementation progress and to address specific topics related to the TMDL Implementation Plans and the Trash and Litter Reduction Strategy. Meetings will be scheduled as issues arise. It is anticipated that the WIP team will provide initial review of newly developed outreach and education materials, in order to provide feedback from a variety of perspectives.

11.4.2 Targeted Outreach and Education

The Small Watershed Action Plan development process includes upland assessments of neighborhoods to identify pollution sources and restoration opportunities. This information will be used to prioritize and target outreach and education efforts specific to the issue(s) in neighborhoods with the intent to affect behavioral change and/or increase citizen based restoration actions. These actions will be tracked and reported in the annual NPDES – MS4 Report.

11.4.3 Small Watershed Action Plans)

Baltimore County has been developing Small Watershed Action Plans since 2008. There are 22 planning areas in the county, with 13 completed plans, 5 plans in development, and 4 areas pending. These planning areas cover the entire county. The planning process includes the development of a steering committee, the composition of which is determined by the issues, and land ownership within the planning area. At a minimum membership consists of agency representatives, watershed associations, and citizen representatives. The process also includes a number of stakeholder meetings, open to all planning area residents and businesses, which provide information on the plan and solicit input. Once the SWAP is complete, the steering committee becomes the implementation committee. As designed the implementation committee is to meet twice per year, however, most implementation committees have not met this goal.

The plans have addressed to varying degrees the TMDLs that are applicable within the planning area. Some of the TMDLs have been developed subsequent to the specific SWAP development or did not address the full range of TMDLs that were applicable to the planning area. The TMDL Implementation Plans are built on incorporation of the actions from each SWAP within the applicable TMDL area. In some cases, additional actions have been identified in order to meet water quality standards.

11.4.3.1 Small Watershed Action Plans in Development and Future Plans

For SWAPs currently under development, and for plans developed in the future, the steering committee and stakeholder meetings will be used for outreach regarding the TMDL Implementation Plans and the progress being made in achieving water quality standards. The meeting participants will be informed on where they can access the TMDL Implementation Plans, the Trash and Litter Reduction Strategy and any Progress Reports that have been developed.

Applicable TMDL Implementation Plan actions will be incorporated into the SWAP based on the assessment of applicable restoration actions within the SWAP planning area. Since the SWAPs incorporate field assessments of streams and uplands, they provide more detailed information on applicable restoration actions, both on quantity and location. The accelerated schedule for developing TMDL Implementation Plans precluded conducting field work to build the plans.

11.4.3.2 Small Watershed Action Plans Already Developed

For those SWAPs already developed, the implementation committee meetings will be scheduled twice per year. The first meeting will be held in winter and will present the implementation progress not only of the SWAP, but also any applicable TMDL Implementation Plan progress. The progress analysis will be based on fiscal year. This meeting will also provide the opportunity to discuss any changes in the SWAP or the TMDL Implementation Plan based on an analysis of what actions have been successful and what actions have been more difficult to implement.

The second implementation committee meeting will be held in fall of each year and will present the monitoring data in relation to progress being made in relation to interim milestones and water quality standards.

11.4.4 Educational Displays at Events

Educational displays and handouts will continue to be used at applicable events as they occur. The particular display and handout materials will be determined by the location and focus of the event. The location and focus of the event, number of citizens engaging staff at the display, and the number of handouts taken by citizens will be tracked for annual reporting in the NPDES – MS4 Report.

11.4.5 TMDL Implementation Plan, Trash and Litter Reduction Strategy, and Progress Report Availability

The TMDL Implementation Plans and the Trash and Litter Reduction Strategy will be posted on the Baltimore County website with hard copies placed in county libraries. The hard copies in the libraries will be specific to the watershed in which the library is located. Progress reports will be posted on the County website and placed in libraries. A set of hard copy plans will be kept at the Baltimore County Department of Environmental Protection and Sustainability

11.4.6 Biennial State of Our Watersheds Conference

Baltimore County, in conjunction with Baltimore City, has held *State of Our Watershed* conferences in the past to present information to county and city citizens on water quality issues applicable to the watersheds in these jurisdictions. Future conferences will be held in early March of even numbered years. Information on implementation progress for local TMDLs and the Bay TMDL will be presented, along with other topics of interest. These conferences will be organized with the assistance of the WAG, and the surrounding local jurisdictions (Baltimore City, Howard County, Carroll County, Harford County, and York County, PA) will be invited to participate in the organization and presentation of the conference.

The timing of even years is related to the 2-year milestone process set up by the Maryland Chesapeake Bay TMDL WIP whereby in January of even calendar years, progress in meeting the previous 2-year milestone programmatic and restoration implementation is reported and the next 2-year programmatic and restoration implementation milestones are proposed by the local jurisdictions. The timing of the conference not only permits reporting on the progress made in meeting the previous 2-year milestones but also what is planned for the next two years.

11.5 Summary of Continuing Public Outreach Plan

A summary of the continuing public outreach plan, by component, element and frequency is presented in Table 11.1.

Table 11.1: Continuing Public Outreach Plan Summary

Plan Component	Plan Element	Frequency
Agencies	NPDES Management Committee	2x per year
	Other Agency meetings	As needed
Environmental Groups	WAG meetings	2x per year
Business Community	Business Forums	As identified
	Targeted Business Outreach and Education	As identified
	Topical Workshop	As identified
General Public	WIP Team meetings	1x per year
	Targeted Outreach and Education	As identified
	SWAP – Steering Committee meetings	6x per year, each
	SWAP – Stakeholder meetings	2x per year, each
	SWAP – Implementation Committee meetings	2x per year, each
	Educational Displays at Events	As identified
	Document availability (various)	As needed
	Biennial Conference	Even # Years

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